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STATE OF MICHIGAN.

MINES

AND

MINERAL STATISTICS

BY

CHAS. D. LAWTON, A. M., C. E.,

COMMISSIONER OF MINERAL STATISTICS.



BY AUTHORITY.

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STATE OF MICHIGAN,
OFFICE OF THE COMMISSIONER OF MINERAL STATISTICS, }
Lawton, Michigan, June 15, 1887.

HON. CYRUS G. LUCE,

Governor of the State of Michigan:

SIR,—In fulfillment of the duties of my office, I have the honor to submit herewith the following report upon the mines and mineral interests of the State.

Respectfully your obedient servant,

CHARLES D. LAWTON,
Commissioner of Mineral Statistics.



THE MINING INDUSTRY.

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There has been great improvement in the mining industry since one year ago. This is especially true of the iron mines. The advance in the price of copper from 10c per lb. to 12c, which occurred during the past year and which price still prevailed early in the present year, caused a feeling of relief in the copper district; the outlook became far more hopeful and increased activity prevailed. But copper mining in Michigan has become a very uniform industry; prices may vary but the work at the mines goes on steadily with little apparent change. There is all the while a gradual increase in the magnitude of the operations, resulting in an increased production and a corresponding lessening of cost.

Comparatively few comprehend the scale on which all the work is carried on at our great copper mines. They do not realize the fact that the rock from which the copper is eliminated must be mined far underground, at a depth of from hundreds to thousands of feet, and thence be raised to the surface, taken to the rock house and passed through breakers, whence it must go to the stamp mill, perhaps several miles away, and there be pounded into fine mud and sand which in turn is run over the system of sieves and jiggers and slime tables, undergoing an elaborate process of mechanical manipulation by which the separation of the copper from the sand is effected, after which the copper must be taken to the smelting works and be cast into ingots, when it is ready to be sent to market.

Few, even mining men, who have not acquainted themselves with the details of the work at our Michigan copper mines, are ready to give credence to the statement of the results which are obtained. They do not readily comprehend how all the various manipulations, which I have indicated, are accomplished at so low a cost. It seems to be a little difficult for mining men in this country and in Europe who have not visited our copper mines to credit the fact that rock which has a gross value of but \$1.65 per ton, that is, rock which contains less than 15 lbs. of refined copper, on an average, to the ton, can be mined at a depth of more than 1000 ft. below the surface, hoisted, broken, stamped,

washed, and separated, smelted and taken to market and sold for \$1.65 and still leave in the hands of the company, after accounting for the cost of all these successive manipulations, a net profit of 22 cents on every ton of rock so mined and treated! Yet such was the year's result at the Atlantic in 1885 and it is equally favorable for 1886, only I have not at this writing the exact figures for data.

Not only was the rock mined and treated, etc., at the total cost of \$1.43½ per ton but a sufficient profit accrued so that a dividend of \$1.00 per share was paid to the stockholders.

In order to accomplish this, 800 tons of rock were raised and stamped per day. Each year, as the price of copper has diminished, the daily production has been increased in order to reduce the average cost. Ten years ago, when there were but 230 tons of rock mined and treated per day, the average cost was \$3.90 per ton at the mine. The cost of stamping and washing was then 88 cents per ton, while now it is but 30 cents. The total average cost per pound of copper obtained at the Atlantic mine ten years ago was 23 cents, in 1885 the same was produced for 9½ cents. The mine is no richer now than formerly; in fact there has been, practically, no change in the quality of the rock. The advantage gained is due to improved facilities for mining and manipulation and to the better comprehension of the work. The problem has been studied in all its details and no effort has been spared to meet all the exigencies which the work demanded. The Atlantic mine has been referred to simply for illustration. There are others which afford an equally favorable showing, and altogether these results make it apparent that no business in the land of equal magnitude is more systematically and carefully conducted than is the copper mining industry of Michigan. There is none more legitimate, scarcely none that rests upon a more substantial basis or that is conducted with more freedom from speculation and from those manipulations of stock which unfortunately too frequently characterize mining operations in many localities.

Lake Superior copper mining, as an industry, falls into the category of those regular, uniform enterprises that are understood as being not unduly risky or greatly liable to fluctuation and ruin. No enterprise, no business can be wholly exempt from danger, and copper mining in this State can be made and is made as certainly profitable as are other undertakings requiring large expenditure of money. The mineral lodes are pretty well understood, it is known, generally, what they will yield, the conditions are understood, the elements of the problem are in hand. The leading mines have demonstrated their ability to meet all the conditions, to so conduct their operations that an annual profit shall accrue with accurate regularity. Mining, like other enterprises, can be carried on with such recklessness and extravagance that utter ruin must result, and if there

are conspicuous instances of failure in the recent history of the copper country, the unfortunate results may be traced to causes that were readily foreseen. The final outcome could have been predicted in advance with all reasonable certainty; while good management, in all instances where the conditions are favorable, has been attended with success.

The progress which has characterized the copper mining industry has also in an equal degree entered into the work in the leading iron mines. Copper mining, of necessity, requires a great preliminary outlay; the work cannot be successfully prosecuted otherwise. The rock, after it is mined, unless it is mass copper, must be crushed and stamped to great fineness and washed to separate the copper from the rock, and the copper finally smelted before it can be sold. All these successive manipulations require the procurement of mechanical appliances that are very elaborate and costly. Great skill and experience are essential on the part of those who have the direction of such work. No copper mine in Michigan can be successfully operated otherwise than by all this necessary outlay. As soon as the deposit has been proven, that is, as soon as it has become established that the lode is sufficiently good to justify its permanent working then the rock house and stamp mill must be provided for. Hundreds of thousands of dollars must be thus judiciously expended before the mine becomes established as a working, paying enterprise.

Not so with iron mines: some of these in their earlier stages are the simplest of excavating work, a mere open pit in which the ore is dug out and loaded into cars. Generally, even when the ore is thus mined from an open cut, more or less stripping must be done before the ore can be reached, that is, the overlying dirt and rock must be first removed. But this sort of mining is only applicable to soft ore mines—hematites—and to these, when true of them, only in the first year or two. Very frequently there are difficulties met with that to be overcome require the exercise of skill, experience and improved appliances to insure economical production. Still the ore only has to be mined, there is no subsequent manipulation required on the part of the mining company to render the ore marketable.

Thirteen years ago all the iron mines in the State, with one small exception, were wholly open to daylight, and the aggregate production was 1,000,000 tons; now nearly all are worked under ground and the aggregate production, annually, has mounted up to 3,000,000 tons. Great change has taken place in the iron mines in the last few years, in the large mines, as the Cleveland, Lake Superior, Republic, Chapin, etc. The old and inadequate machinery has given place to that of the most costly and powerful character—for hoisting, for pumping and for drilling. The wooden buildings in which the machinery was formerly held have been supplanted by stone structures with iron roofs, which are safe,

substantial, spacious and elegant. Ponderous steam engines, air compressors and immense winding drums that have nearly the intricacy and perfection of workmanship, combined with the certainty of results desired, that pertain to the chronometer, are the order of the day and such are found in all our great iron mines. The use of the electric engine for lighting the buildings, the surface and the interior of the mines is becoming general; the electric bell for signalling is rapidly coming into use, securing rapidity and greater certainty in announcement.

At the Chapin, Ludington, Vulcan, Lake Angeline, Lake Superior Hematite and Barnum mines, which have vertical shafts, cages are used instead of the skip ordinarily employed. In one particular, at least, the use of the cage in shafts is an important change for the better, since the men are thereby enabled to get into and out of the mines without undergoing the excessive labor incident to descending or ascending the ladders. The danger is also greatly lessened. There is very little liability to serious accident in using the cage. The machinery is so perfect, so easily controlled that the cage is run with great steadiness. The best steel wire rope is used of a strength that eliminates nearly all possibility of its breaking; but even if this should occur, the frequent tests that have been made have demonstrated the fact that the safety-clamps with which the cages are provided will act to stop it instantly. The men are taken down into the mine or brought up from it without loss of time and without labor; thus the cage is not only a saving of labor to the men but it economizes time. Ordinarily, where the miners have to "climb the ladder" 500 feet or more to get to the surface they are obliged to "knock off" from work 15 or 20 minutes before the "blowing of the whistle" to begin the ascent from the mine, and this ascent, after a hard half day's work, is a serious matter. And the same is true in going down; they reach the bottom of the mine pretty well tired out. Whereas, with the cage, they gather at the shaft at the different levels in which they are working and stand upon the cage, usually nine men for a load, the signal is given and in less than a moment they are at the surface; a brief space suffices to take up all the men, and with the same economy of time they are let down to their work. Climbing the ladder is one of the most laborious parts of the miner's work, and thus the introduction of the cage is in this respect a change for the better.

Another important innovation has lately been made in the work in the iron mines, which is the practice of filling up the spaces from which the ore has been extracted. Until within a year or two no instance of this method was to be found in our mines; now it is practiced at a number of them and it is a notable advance in mining.

In all of the hard ore mines and in some of the hematites the walls are kept

in place where the ore has been extracted by leaving pillars of ore; these are of such size and in such position as in his judgment the mining captain shall deem necessary. Occasionally stull timbers are added to hold fragments of rocks in place. In some hematite mines, where the inclosing walls of rock are uniform, with little tendency to fall, and where the ore also is hard and compact and remains firm in the pillars large rooms are left, sometimes of great breadth and height, and this is done with entire safety, the nature of the rock and the ore being such that they will stand.

Frequently, however, a good deal of the ore is left in the mine in the pillars and floors to the levels, which latter also serve as pillars to sustain the walls. Especially is this the case where the shafts are in the ore, then usually heavy ore pillars are left upon either side of the shaft in each level to insure its permanence and safety. More recently it has become the practice to seek to have the shafts in the rock and avoid having them in the ore. When it can be done the foot wall is the side selected, since a shaft in the foot wall has no liability to disturbance. When the shafts are in either wall of the vein the ore is reached by tunnelling through the rock to it, which drifts are termed cross-cuts.

In many hematite mines, which are worked underground the walls are supported by timbers arranged on a plan after what is termed the Nevada system. This system is very simple and when the timbers are suitable and well placed it is very effective—far better than any other plan of timbering that has been devised. It consists of posts and caps, either round or square. The former are generally 7 feet long and have a square 4-inch tennon in the center of each end; the latter are 9 feet long and are squared at the ends so as to be fitted on the posts. They are put up in what are termed “sets;” starting from the foot wall the posts are set in the line of greatest pressure, to which the plane of the caps will be at right angles, that is, they will lie approximately, parallel with the walls of the ore deposit. The posts are set as the work progresses, exactly one over the other, so that they form a straight line and the caps, the ends of four of which rest on each post, radiate at right angles so that each line of caps is a straight one. The joints are made to fit with precision so that there is no give nor play in them, and the outside timbers are “shored” firmly against the walls. It will thus be seen that each “set” incloses a rectangular volume 7 feet x 9 feet x 9 feet, one set exactly over another, timbers and rooms all placed in line. Thus there can be no swaying or knuckling when firmly placed and can give way only by crushing.

Most generally when this system of timbering is used it is combined with ore pillars, that is, the ore body is worked in rooms or headings regularly alternating with ore pillars which are left. Openings 18 feet wide across the ore are made, which are separated by pillars of ore of equal width.

The openings are timbered in sets and the sides of the pillars are lagged up, the lagging being wedged firmly between the ore and the uprights.

When the ore is soft and will not remain in place only as it is held there, the heading is made by advancing from the foot wall side with one line of sets; as fast as it is opened ahead far enough for a set, the timbers are put in place. If the ground is so "bad" that it will not hold up the length of a set, temporary timbers are used a little way in, to be removed when the full set is completed. Generally, in advancing the headings in these soft hematite deposits it is necessary to hold up the "back" of the drift ahead of the timbers. This is done by laying a timber on top of the final cross cap and then thrusting poles ahead, which rest on top of the cross piece and incline downward back into the drift. They are driven ahead as the work advances and protect the workmen from any fall of the ground. A second line of sets alongside of the first is in like manner opened out in the same heading; the sides against the pillars are lagged up between the ore and the timbers and short pieces are set against the walls at either end of the heading, and thus the pressure is provided for in all directions. These two sets constitute the width of the heading—sometimes they are three sets wide and even four; but two or three sets wide is the usual number; leaving an eighteen feet pillar.

When the bottom sets are completed they are covered over on top and the ground above is worked out in the same manner and a second series of sets is formed directly over the first. The tram cars, which run on the track that branching from the one in the main drift, come in on the bottom of the heading below, receive the ore which is run down into them through suitable openings. And thus in succession, one series of timber sets above another, the ore is mined out up to the level above until, if no "floor" is left, the ore is all taken out and the timbers come up exactly beneath those which are already placed above. Surveys are made so that the headings are started directly beneath those above.

It will be seen that very much ore is left in the pillars, generally about one-half; sometimes when heavy floors of ore are left two-thirds of the ore remains in the mine. It is of course the intention to remove this ore subsequently, and at some mines this work of mining out the pillars has already begun. Valuable experience has thus been speedily acquired. As a general fact it has been found that these ore pillars cannot be removed with safety without first filling the rooms with sand, etc., and rock. At several important mines this operation is in progress—extracting the ore by first filling the rooms and then cutting away the pillars, either proceeding in the same manner as when making the original headings or filling up the vacant space as fast as the ore is removed—thus virtually filling the whole mine.

Wherever filling is practiced it is meeting with general favor, it insures per-

fect safety, the saving of all the ore and is not usually more expensive than other methods; probably in the long run in all large mines it is far the most economical plan.

The method of extracting the ore and filling the mine is naturally varied to meet varied circumstances. Where the ore body is not too wide or where the ore is dry and stays well in its place, the stope is carried the whole width of the vein and the space filled up to near the "back," the filling is leveled off and planked over to receive the ore that falls upon it, then another stope is carried forward to a suitable height, the ore and plank removed as the work progresses, and the filling brought up again to near the "back," and so on the work proceeds.

It is well to state that a main drift is first made in each level, as it is reached by the shaft. This opening drift is ordinarily along the foot wall in the ore and is well timbered and made secure for permanence and safety. As the ore in the level is mined out it is run down into the tram cars in this drift through openings that are carried up through the filling as the work proceeds. These shuttles are termed "mills" and the work is designated as "milling down the ore." Similar "mills" left through the filling in the level above suffice for avenues through which to run down the rock and dirt as required.

Where the ore body is wide or of such a character that it will not hold up very well the filling must follow close upon the stoping and the back be kept blocked up.

To accomplish this the ore body is first opened by cross drifts from the main drift to the hanging wall made at suitable distances apart, 50 ft. to 100 ft., and carried at about 8 ft. high and as wide as the ground will bear. Then along these drifts breast stopes are carried forward each way lengthwise with the deposit, and as the stoping progresses the space behind is filled up to the back. In the same manner on top of this filling other stopes are afterward opened and the ore is mined out and the filling proceeds as before. "Mills" best for running down the ore and for receiving the filling are built up and kept open along the main drift.

Still another method is to mine out the ore and "let in" the overlying earth and rock to the surface. There are several ways by which this is accomplished, but essentially this plan consists in drifting from the shaft to the extremity of the ore and securing the drift, then working a stope of suitable height and advancing towards the shaft allowing the "surface" to come in in the rear. In this manner the level is worked from the top downward, the stoping being all the while under the filling.

No system of timbering, however well done, will hold a large mine for any considerable depth; it must be either filled or wrecked.

As before stated, there is constant progress in all our mining region, obsolete methods speedily give way when something better is devised. Our mining men are ever on the alert to appropriate whatever is new that is to their advantage. There are no men in any great industry who keep abreast with the times, in their business, more thoroughly than the mining men on Lake Superior. Not only is the great improvement in the machinery used more powerful, more rapid and more perfect in its action, but everywhere, in every department of the work, one meets with changes, with improvements with many ingenious contrivances that betoken energy and intelligent forethought; generally, too, one observes those indications which suggest good management.

Sometimes mining work is very simple, discoveries of ore are made and a mine opened by simply "stripping" off the covering of earth, sand and gravel, etc., which if the deposit prove to be large and the ore of good quality, a good deal of money may be made the first year or two, or until the mine reaches considerable depth, when powerful machinery and other expensive appliances are required. But ultimately mining becomes difficult work. And it is only by large outlay, judiciously made, long experience and skill in the work, energy and economy that success is met with. I have already stated what is accomplished in the great copper mines, and the same intelligence, energy and progress are in an equal degree manifest in the iron region—in the work in the leading iron mines. The old mines have attained to considerable depth and the ore must be brought from far below the surface, but the result is accomplished without additional relative cost. The ore is sold cheaper and is mined cheaper than formerly, notwithstanding the increased depth which the mines have attained. More powerful and improved machinery, high explosives, air drills, greater energy, intelligence and economy of working have increased the output and lessened the cost.

The quality of the ores is a matter that enters more and more into the matter of this production. Ores are sold now on their determined qualities. It is no longer a matter of assertion, of estimate, but the average percentage in iron, phosphorus, silica, etc., of the product of the mine, must be known to a certainty. This fact is ascertained by analysis of specimens—not one but many—so collected as to represent, as nearly as possible, the average of the stope, stock pile or cargo. Nearly all the large mines now have a laboratory and chemist at the mine, and in some cases analyses are constantly making. At one of the mines in Ishpeming, in the past five months, 300 analyses have been made of the ores of the mine.

At the rolling mills and furnaces in Chicago, Cleveland and Pittsburg chemists are also employed, and the ores undergo equal scrutiny at that end of the line. Skillful furnacemen now buy their ores by analysis with reference to the

manufacture of certain kinds and grades of pig metal. They know from the analysis what proportion of ores of different mines to purchase and what proportion of each to use in the mixture to obtain the kind of metal required.

Owing to the rapid increase in the use of Bessemer steel for the manufacture of rails the demand for ores suitable for Bessemer pig metal has greatly extended. The first demand regarding the quality of any newly found ore is, whether it is Bessemer? what is its percentage of phosphorus? Iron and silica contained are of minor consideration. The most important question—the one that settles the value of the ore—is whether the relative proportion of phosphorus and iron contained is such as to place the ore within the Bessemer limits. The lower the percentage of phosphorus in proportion to the iron contained the more valuable the ore.

GOGEBIC.

In the last year or two the limits of production of Bessemer ores in our State have been greatly enlarged. Some new deposits have been discovered in the Marquette district, while the opening of the marvellously rich Gogebic range has added several new mines which are large producers of this class of ore. The list of this class of mines is rapidly extending.

Exploration is very active in the Gogebic range; new companies are daily forming, and important discoveries of ore are frequently made, and the number of producing mines in another year will perhaps be double that of the past year, and to what limit the range may extend it is impossible to decide; it has already been explored with very promising results, both east and west, far beyond the originally prescribed limits.

The Gogebic range is divided between the States of Michigan and Wisconsin, that portion lying west from the Montreal river being in the latter State. The most productive mines thus far discovered, are in Michigan, and from these mines, lying in Michigan, there was shipped the past year nearly 700,000 tons of ore.

This ore is all Bessemer, is well up in iron, and much of it is otherwise exceedingly valuable in the fact that it contains a good percentage of manganese. Manganese in low phosphorus ores is esteemed a desirable combination by the steel makers. 1886 was the first full year in which shipments were made from the Gogebic range; they began in the fall of 1885 on the completion of the Milwaukee, Lake Shore and Western Railway from Ashland to the mines, and a limited amount of ore was sent to market ere the close of navigation. The railroad rate to Ashland is 80c per ton and the lake freights thence to Cleveland averaged about \$1.54 per ton for the past season. The Gogebic ores sold in the Lower Lake markets the past season for \$5.00 per ton

average; probably they will sell fully a dollar on a ton higher in 1887, but there will also be an increase in the lake freights to lessen the margin of the gain in the price. The Gogebic range is a very pleasant region of country; far to the north is seen the high broken lands of the trap range which bound the iron-bearing series in that direction, and to the south is the granite. The rocks in which the ore deposits are included are deeply covered with drift, which constitutes an excellent soil for the support of vegetable products. Between the granite and the mountainous trap range the land is gently rolling and covered with a fine forest of hard wood timber, chiefly sugar maple. It is good farming land and in time must become a fine agricultural region.

The only thing against it is the climate, which is of course severe, but to offset this are the advantages of a good market due to the large mining population which this region will be sure to contain. The extraordinary development that has been made in the Gogebic range in so brief a time is surprising. No one could have conjectured that the ore deposits which have been developed should have proved to be of such magnitude or of such excellent quality.

The towns on the range which have grown up so quickly have a substantial character. Some of them are better than are usually found in a mining region, even when of much older date than is this newly settled section. One can scarcely realize that it is barely two years since almost the first blow was struck; yet there are hotels and private residences of elegance rarely excelled or equaled in the northern country.

The extraordinary success which has attended some of the mining ventures of this range, the fortunate outcome of many of the explorations that have been made and are constantly making, the uniform general excellence of the ores that are found, have stimulated in a high degree the hopes and enthusiasm of nearly everyone who has any interests in the region. Many fortunes have been realized. Scarcely a day passes but some new "finds" of ore are announced, and accounts of sales of property are reported by which fabulous sums accrue to the fortunate vendors. Stocks advance with a rapidity that one must catch them on the whirl if he designs to become a possessor. The fabulous sums, which, rumor asserts, represents the purchase price of some important mines that have recently changed owners, are enormous.

It seems hardly credible that a property comprising 40 or 80 acres of land which within so brief a time was forest primeval wherein the wild deer browsed undisturbed, should suddenly develop hidden wealth that multiplies its value thousands of times! That the simple lease of an estate, of such dimensions, from the surface of which the forest has scarcely been removed should sell in the market for more than a million of dollars is astonishing beyond measure. But such is the expectation of profit, faith in the continuity of the deposits, and

speculative fever, that these reputed transactions doubtless really occur. Certainly there are sales made of mining properties at astonishing figures; and stocks are quoted and sometimes sold of mines, when, in some instances, but a meagre development has been made, at prices which represent an aggregate value of hundreds of thousands of dollars!

But while the fever of speculation runs high there is much that is real for a foundation for all this seeming exaggerated hope and expectation. There are some, apparently, immense deposits of excellent ore; these can be seen and examined, and furnish solid facts to be used to "boom" much that is unreal or imaginary.

The whole length of the range so far as it has been explored is dotted with so called mines; there is a mine on nearly every "eighty" for a length on the range of 20 miles. Many of these are thus far merely explorations, mere beginnings, where they have either not yet reached the ledge with their sinking, or have not succeeded in finding ore. Some have got ore, but as yet in small quantity.

It takes time to open a mine; certainly where there are no exposures, where the ledge is covered with thirty feet of drift, the work of development of discovery even, is slow, expensive and uncertain. But unfortunately, or fortunately, according to the way one looks at the matter—as his interest lies—zeal for investment does not seem to be dependent on any such tedious process. Gogebic mining stocks are bought and sold very extensively. Parties are eagerly seeking for opportunities to invest and new "locations" are made, "options" and leases obtained, companies organized and stocks issued to meet the demand. Not unfrequently there is nothing apparent but this fact that the land is on the "range" and is crossed by the ore formation—imagination does the rest. It seems that there are not a few people who are abundantly endowed with this faculty, who possess a sufficient amount of fancy to enable them to see beneath the overlying surface magnificent deposits of ore of which the Colby is but the counterpart.

There is much to keep up this hope, in all honesty; discoveries are constantly making along the range and many good "finds" of ore have been made—enough, certainly, for the basis of large expectations.

The formation of the Gogebic range is more regular, at least it has that appearance so far as it has been developed, than are those of the Marquette and of the Menominee iron districts. And this fact, notwithstanding the many difficulties connected with exploration even here, makes the work of discovery more easy and certain than it is elsewhere in the iron region. The ore formation here seems to partake somewhat of the regularity of the copper rocks—the trap—which bounds it on the north. To the south is the granite, and

thus the iron bearing rocks are situated, for a portion of the extent of the range, between the trap on the north and the granite on the south dipping north at a steep angle. The deposits of ore thus far discovered seem to be between a so-called quartzite foot and a slate hanging. Explorations with favorable indications and results are pushed with great zeal and rapidity both east and west, west into Wisconsin and east into Michigan. A year ago the limit of discovery in the latter direction was in the vicinity of Sunday Lake, but exploring work has been extended many miles east of that point, and it is likely from what has been found so far east as Marensco and Watersmeet, that ore in paying quantity exists.

An important matter connected with the Gogebic range is the fact that the Chicago & Northwestern railway company is now at work extending its line from Iron river northwesterly to the Gogebic mines. By a glance at the map it will be seen that this extension follows the same general course of the railroad along the Menominee range.

Geographically the Gogebic range mines are in the line of the prolongation of the axis of those of the Menominee range. This extension will intersect the Milwaukee, Lake Shore and Western—the line which now supplies the Gogebic mines—at Watersmeet. When the extension is completed the Gogebic ores may be sent to market by the way of Escanaba on Lake Michigan.

The villages of Bessemer, Ironwood and Hurley are the most considerable towns on this range and they show a great deal of prosperity. The latter has a fine hotel, one of the best in the northern counties. This region has received a good deal of attention lately through the press and at the hands of the courts that has given it an unenviable notoriety, for the alleged immoral condition of its society. However, one sees outwardly a great deal of activity and apparent prosperity, with such mingling of the debasing elements as unfortunately too frequently pertain to mining towns in the earlier period of their growth.

The Gogebic range, as well as the whole upper peninsula, is sure to be greatly benefited through the completion of the railroads, now under construction, from Duluth along the south shore to Ashland and then through the peninsula to the Sault de Ste. Marie. This road will afford an outlet for the minerals and timber—hard wood, pine, cedar, etc.—both to the northwest and to the seaboard. It must thus greatly accelerate the development of the mining country.

During the past year the Milwaukee and Northern has completed its line from Menominee to Iron Mountain and is now engaged in building a further extension to Republic and thence to Ishpeming. This company will carry ore over its road directly to market, using large ore cars holding 20 tons each, the same capacity as those used in the Gogebic range.

There are other railroad extensions in contemplation in the Upper Penin-

sula which, if carried into effect, will also have an important influence in promoting its prosperity. Altogether it is quite probable the coming year will be a period of great activity in the Northern Peninsula in this line of business.

In view of the fact that there were upwards of 8,000 miles of railroad built in the U. S. in the past year, and that this amount will probably be exceeded in 1887, it is apparent that were it not for the large production of the Gogebic and the new Minnesota districts there would be a dearth of Bessemer ores.

But the newly added districts will doubtless enable the Lake Superior mines to keep the supply of this ore up to the demand. Thus timely discoveries seem to be made to meet the increasing needs of the country. The demand has changed from iron to steel, but our native resources are such—an abundance of the requisite raw material—that the industrial stability resting thereon is not likely to be disturbed.

During the past year an unusual number of valuable discoveries have been made in the iron region. A more than average amount of good fortune has attended the efforts of explorers, and not a few men who began the year 1886 poor in purse are now comparatively rich; having succeeded in uncovering deposits of ore on lands secured by options, which claims they have, under such circumstances, been able to sell, in some instances, for large sums of money.

A great number of fortunes have been realized in this way in the past year, in the Upper Peninsula.

One of the features connected with these discoveries is the fact that some of them have been made upon lands among the earliest occupied in the settlement of the country; upon lands that have been used for years by persons who had no suspicion that by digging a few feet beneath the surface they could find bodies of ore that would insure their fortunes.

But in point of fact the iron bearing rocks of Michigan are of great extent, much greater than was originally assumed. Territory that has been laid down on the maps as Laurentian is really Huronian, and consequently iron yielding, and as time goes on it is likely that iron mining districts will be increased and extended.

The price of ore has varied, of course, according to quality.

The best hard bessemer, specular, has sold in Cleveland in		Average Price.	
1886		\$6 00 to \$6 25 per ton.	
Best hard specular ore, non-bessemer		5 20 to	5 50 " "
Best hematite bessemer		5 00 to	5 25 " "
" " non-bessemer		4 00 to	4 65 " "
High phosphorus hematite		3 00 to	3 50 " "
Ore freights to Escanaba from Ishpeming		80 cents per ton.	
" " " Marquette " "		55	" " " "
" " " Escanaba " Iron Mountain		80	" " " "
" " " Ashland " Bessemer		80	" " " "

Lake prices from Escanaba to Lake Erie ports.....	\$ 90 to \$1 75 per ton 1886.
“ “ “ Ashland “ “ “	1 00 to 2 00 “ “ “
“ “ “ Marquette “ “ “	1 15 to 1 50 “ “ “

The following table, furnished to me by Mr. W. B. Linsley, division superintendent of the Chicago & Northwestern R. R. Co., is of interest and value. It shows the ore shipments from Escanaba from 1865 to 1886 inclusive :

Year.	Tons.	Year.	Tons.
1865.....	31,072	1876.....	412,372
1866.....	116,868	1877.....	424,040
1867.....	196,831	1878.....	527,957
1868.....	273,405	1879.....	847,209
1869.....	331,660	1880.....	1,242,100
1870.....	413,786	1881.....	1,529,000
1871.....	447,253	1882.....	1,815,000
1872.....	481,982	1883.....	1,485,324
1873.....	453,416	1884.....	1,401,206
1874.....	321,402	1885.....	1,269,605
1875.....	299,827	1886.....	1,569,606
Total.....			15,890,962

In describing the iron mines I shall speak of them as they occur in succession along the several ranges, commencing with the Penn Iron Mining Co., at the eastern extremity of the Menominee range.

THE PENN IRON MINING COMPANY

was formed in 1881 and is the proprietor of several mines, consisting of the East Vulcan, West Vulcan, Norway, Cyclops and Quinnesec, all of which mines were opened by the Menominee Mining Co., and sold to the present owners in 1881. The purchase was made not as a matter of speculation, but because the buyers wanted the ores to work up in their own furnaces and the iron in their own mills in Pennsylvania. Consequently the ore is sent from the mines to Johnstown.

The ore is nearly all Bessemer of the best quality of soft specular and the mines are in excellent shape, showing no discouraging features. The Vulcan mines and the Norway have as much ore in sight now as at any time since the present owners have held the properties. The last year's product of 243,000 tons of first class ore, is suggestive of the capacity of the mines.

The mines of the Penn Iron Co. are exceedingly well managed. The officers

are experienced men in the iron business and understand its details in all departments of the work. During the past year the general management of the mines has devolved upon Mr. J. E. Hagey, through the retiring of Mr. Wm. R. Babcock. Mr. Hagey having been an officer of the company for some years past merely assumes a position of increased responsibility, the duties of which he has already demonstrated his fitness to discharge. The Penn is among the best iron companies in the State. Everything shows thoroughness, efficiency and good management. The men are well paid and are contented. The buildings are substantial and conveniently arranged. The surface is clean and orderly; the ore docks are commodious and ample; the shafts are in good shape; the mines are well opened underground, safe and well ventilated. The men are relieved from the toil and loss of time incident to climbing ladders, since they are taken down into the mines and brought again to the surface on cages, which are nearly as safe and convenient as the elevators in hotels, etc. Changes for the better have been gradually made at the mines of the Penn company ever since they have been in possession, until now they are in the foreground in appearance, in mining work and in equipment. It gives me pleasure to speak thus favorably of these mines, for I am able to contrast their present thrifty appearance with the wild and primitive look of a few years ago. This matter of improvement is especially noticeable at

THE EAST VULCAN MINE,

which is situated in the S. $\frac{1}{2}$ of the S. $\frac{1}{2}$ of Sec. 11, T. 39, R. 29, and is the most easterly of the Menominee range mines that is operated.

It is a very singular mine and can never have been a profitable one to work. It is in most excellent shape in all respects; but it has cost a good deal to make it so and the ore deposits have never proved large enough to afford a very great remuneration.

The ore is of the best quality, it is too good to abandon, the company wants it for its own furnaces, and for this reason the proprietors probably find recompense for the outlay.

There are three shafts—three separate mines—but the middle one, No. 1, it is called, is the principal ore producer.

No. 1 is a chimney of blue ore of variable dimensions, but generally about 90 feet horizontal measurement either way. It is 500 feet deep, vertical, with cage to bottom. The ore deposit went down vertically about 200 feet, when it abruptly took an inclination to the west of about 27° , so that at the bottom the cross-cut from the shaft to reach the ore is 425 feet long. As the inclination of the ore body continues the cross-cut in the next level, 200 feet further down, would be upwards of 800 feet long. The ore body in the bottom is 90 feet by

110 feet, it is clean, beautiful ore of the best quality and shows indications of widening. It certainly is not growing smaller, it may do so of course, as that is a matter that can be known only so far as the ground is "proved." The plan heretofore pursued will probably be discontinued; it is too big an undertaking to sink 200 feet in the rock and then drift 800 feet to reach so small a body of ore. The plan contemplated is to sink a new shaft from the surface. That the ore continues is shown by the diamond drill boring now in the bottom of the mine; the drill is in 114 feet, all ore.

It is far better to sink a new shaft. The cost would not be greatly in excess of sinking the present shaft and making the long drift, and then all the ore would have to be trammed through this cross-cut. The new shaft would go through ground to the west that has not been explored and might cut a new lense of ore. There are reasons for supposing this to be quite probable. The new find, to be spoken of hereafter, may hold down in the direction to be cut by the new shaft. Capt. Curnow, superintendent of the mine, who is a thorough miner, has many original plans in doing his work. Among others a method of shaft-sinking which he follows, as he states, to advantage.

He sinks through the rock, puts in the timbers, air and water pipes, etc., in fact completes the shaft as it goes down. This he accomplishes by providing for the cage to descend to the bottom as the shaft is lengthened. A bucket is taken up or lowered, as required, by being suspended to the bottom of the cage. In this way the loose material is got rid of. The men work in the shaft in safety; the hoisting, too, goes on above them without exposing them to special danger. The timbers are suspended in the shaft by long hooks in the corners. When a new section is added below it is held in its place by these hooks attached to those above.

In this way No. 1 and No. 2 shafts have been sunk and he is thoroughly convinced of the advantages of his method.

Capt. Curnow states that No. 1 shaft sunk in rock, size 17 feet x 8 feet, cost, completed, timbers, ladder-way, pipes, cage, etc., \$24.25 per foot. He says he can sink the new shaft within a year at a cost equal to or not greatly in excess of the above figures.

There has been a great deal of exploratory work done in this mine, which adds to the cost of the ore. There does not seem to be any way to avoid it, drifts have been made in all directions in search of ore, sometimes they have led to good results but oftener they represent so much that is loss. Still this work must be done, without it the mine would long ago have stopped. It is plain to see, in examining the mine, that these costly drifts have been the means of keeping it alive.

The lense or chimney of ore has corkscrewed its way through the ground

and finally taken a roll to the west in such a way that it was only by a good deal of drifting that it could be kept track of.

In my last report on the mines I have described the method of timbering in the East Vulcan. There is none better anywhere. I doubt if there is any mine in the State in which the timbering is as well done as in this. There is no give to it anywhere; it is all in perfect shape in every part of the mine and the ore is all taken out; not a scrap of it left in any form. They even use wire screens to save the ore, that is in freeing from rock the ore that is found along the sides, etc. The great secret of Capt. Curnow's success in his timbering is that he watches it all carefully himself. He allows no weak pieces to go in. The timbers are all nicely fitted at the joints, put firmly in place, exactly in line in all directions in which the timber runs, securely held so that it cannot give in any way without crushing. "Put the timbers exactly where they belong and secure them there, horizontally and vertically, so that they cannot move," is the motto, and that this is true at the East Vulcan accounts for the fact that the timbers remain as they were placed. It is quite possible that in some mines the collapse of the timbers is due to the giving way at some weak place. It is generally true that in structures of this sort the whole is no stronger than the weakest place, and thus, if the work is ever so well done as a general fact in any mine yet a few defects must render the whole comparatively valueless.

Capt. Curnow has guarded against any defects, and thus his timbers are as well in place as when they were first set.

In this shaft they reach from the bottom 500 feet up to the surface rock. The rock that is broken in the mine is left on the timbers, and in some places also immense masses of the hanging rest on the timbers also.

There is not very much of interest to be said of No. 1 mine in addition to what I reported last year of the underground workings. Since my last report they have drifted in the third level—350 feet down—100 feet west on the west side of the shaft, and made a rise in the ore 110 feet. Here they have a small body of ore in which they are now stoping east and west. In this level there is no ore east of the shaft. They also in this level—350 feet—drove south 175 feet.

In this cross-cut, at a point 86 feet south of shaft they "drove" west 75 feet, much of the way in ore, and at the end of the 175 feet cross-cut they also drove west 61 feet, and a third westerly drift 48 feet long was made at a point 110 feet south from the mouth of the cross-cut.

In the second level on the south side of the shaft they drove a cross-cut 110 feet long and found a body of ore 110 feet long and 25 feet wide. Also they drifted from this ore east 25 feet and 20 feet west; found only rock. They also sunk in the ore body a winze 25 feet deep, but it proved inexpedient to

continue on account of the water. They made a rise up to the first level in the ore and have worked it all out "up to the grass roots."

The bottom is ore and yet remains to the third level to be stoped. West of the shaft in the second level for 215 feet are the old workings, but from the west end a drift to the south, which was made led into a body of ore that they have worked out up to the surface capping. From the west end of this working they have driven west 160 feet and the end of the drift is in ore and rock. There is a stream of water carried from the breast of the drift which is esteemed a good indication of the proximity of ore in quantity.

West of the shaft, above the workings just described, up 152 feet from the bottom of the level, they drove west 42 feet in jasper and then struck a new body of ore, which has been worked up to the sand rock that forms the horizontally bedded capping to the ore.

They have stoped out a space 95 feet by 90 feet, 13 feet high, and the ore continues north. They have drifted 160 feet from the end of the stope, following the ore under the sandstone. It is probable that this ore will continue down, following the roll in the formation. It lies in the soap rock and it should continue with the soap rock down. The jasper lies on the south side of it and they are stoping north, east and west. They have thus far—January 1—mined about 600 tons in this deposit, all of which is in stock, at the mine. They use a compressor and power drills.

The water in No. 1 is raised with 10" plunges 370 feet and a 13" draw lift 165 feet, which latter goes to the bottom.

No. 2 shaft, lying east from No. 1, 1,700 feet, has been opened up new the past year. The shaft is vertical, 241 feet deep, and is worked with a cage. The cage, pump, new engine house, machinery, etc., have been added in the past year. The pump is 12" plunger, 146 feet to first level and draw lift 110 feet to bottom of dump. In the bottom level they have drifted east 95 feet and struck the ore at 65 feet; are now in ore. They then drove south 18 feet and made a rise of 10 feet and "holed" into the old workings, or what was once called the Isabella mine. It was opened two years ago by Capt. John R. Wood and furnished about 375 tons of ore. This property is now held by the Penn Co. and is a part of the East Vulcan mine.

They will open out here and then proceed to stope the ore. In the first level they drove north 400 feet, and at a point in this drift they have gone west 365 feet, all in jasper. They hope to come in under the ore which was found, formerly, in the north vein and was worked six years ago. Here were two good stopes at that time, and the drift will come under the ore body in which they were worked, so that there is no reason to doubt of a favorable result. All this is new work, done in the past year. The more recent workings in No. 2

are those in the bottom to the east which I first mentioned. The bottom level was only opened in the last of the year. The opening work thus begun will be continued and drifts will be extended under all the ore bodies that have been found above.

No. 3 shaft is on the hill 1500 ft. west of No. 1. It is 273 ft. deep, is also vertical and worked with a cage, has the same kind of machinery as the others only the pumps are 7 plunger, drums, 5 diameter, Warner's pattern. They are preparing to pump out the water from the mine. It has been idle for 3 years. There is a good body of ore in the mine but it is not Bessemer and the company has not cared to mine it until now. The ore is run from the shaft down to No. 1 ore dock on an incline.

All shafts, as before stated, have single cages; their advantage is great, save the men from climbing long ladders and save time. The men gather at the shafts when the whistle blows and are speedily transferred to the surface. It is also safe. Capt. Curnow has tested them by loading the cages with material and finally with men, having previously attached a hemp rope which he caused to be severed. The safety clutches stopped the cage quickly without the least harm being done. The men feel assured of perfect safety now. The cages run very smoothly and are light. They weigh 825 lbs. and the car 700 lbs. so that there is not much dead weight.

The product of the East Vulcan in 1886 was 37,049 tons.

The company employs a chemist and there are many analyses made of this and of the ores of the other mines. I was shown several analyses of East Vulcan ore that showed a percentage of iron above 68 and of phosphorus .030 per cent.

The mine is too good to give up but not good enough to pay largely. The expenditures, which are heavy, make the ore cost too much. The timbering in this and in the West Vulcan costs 37c per ton of ore; this seems a large sum. The mine gives employment to 135 men.

There may be a better future in store for the East Vulcan. The limited deposits may open wider and the hoped for period of prosperity may be ultimately realized.

Capt. John U. Curnow still remains superintendent of the mine.

THE WEST VULCAN MINE.

Going west somewhat more than a mile we reach the West Vulcan, which at present is the largest producer of the Penn. Company's mines, and which is perhaps, considering the quality of its ore, the best one in its list. It is certainly a good mine, and although it yielded 106,181 tons of ore the past

year, it is looking, underground, fully as well to-day as it has at any time in the past five years.

There have been many improvements at the West Vulcan lately. The new vertical shaft has been completed, 568 ft. from collar to bottom. It is 10x16 feet inside the timbers, is divided into four compartments and is double cage. The new engine-house is completed, machinery all in place and working. A fine ore-dock has been made to the east of the new shaft. The new pump is in operation, and all the facilities for a more concentrated and economical working of the mine have been completed. The new upright shaft is in the hanging wall of the south deposit, and so placed and equipped that it may suffice for the work of the whole mine. At present in it and in No. 2 all the hoisting is done.

It will be remembered that the West Vulcan has been worked in two separate deposits, both running east and west, and being opened in the side hill that slopes to the south, in which direction the ore also dipped, especially the north deposit, which underlays more rapidly, so that at the bottom they are 200 feet nearer together than they are at the surface. All the machinery, etc., for operating these mines was situated on top of the hill from the surface of which the shafts started. When the mine had reached a depth below the horizon of the bottom of the hill, the hoisting and pumping, etc., through this additional elevation was all dead work. To obviate this useless hoist and to concentrate the machinery, and thus quicken and cheapen the work, is the purpose of the new shaft. As the dip of the south ore body is now nearly vertical, the fact of the shaft being in the hanging wall is not greatly objectionable. All the shafts in the north deposit have been abandoned, the ore is brought out through a cross-cut into the south mine.

The bottom is the eighth level which has recently been reached, but as yet (January 1) is not much opened. The ore deposit has neither shortened nor narrowed in the lower levels. On the contrary, it has somewhat lengthened, as for instance, in the sixth level it measured 570 feet in length; while in the seventh it had increased to 600 feet. The eighth is not fully opened, but the indications, so far as I could judge, favor the continuance of the increase by lengthening westerly. The average width is about 25 feet. They still pursue the same method of mining as heretofore, that is, they work out the ore in rooms, and put in the Nevada system of timber sets. The ore pillars are left 100 feet apart, and as the ore is stoped out in headings across the deposit, the timber sets are put in; but an important modification to the plan heretofore pursued, is rapidly progressing, to-wit: they are filling the mine in the old rooms in the upper levels with all possible diligence. A good deal has already been accomplished in this way, and it is expected that, perhaps, in another year the timbering will be entirely abandoned and the filling process will be begun from the

bottom and carried on side by side with the stoping. As yet they are filling up the rooms above and stoping away the pillars of ore, and also filling the space thus made vacant. In the first, second, and third levels the floors and pillars of ore have been taken out and the space filled in with sand and rock, etc. In the fourth level in the east part of the mine there were three of these pillars of ore to remove, and also the floor of 140 feet in length near No. 2 shaft. This ore mined in the fourth level finds its way out of the mine through No. 1 shaft which is kept open solely to accomplish this particular work.

In the fifth level the pillars have been mined out, but the floor on the whole length remains and will also be removed. Between the fifth and sixth are three pillars and the bottom of the sixth, 22 feet thick, to mine. In the seventh level are three pillars still all the best have been mined out through to the bottom of the sixth level.

A fine addition to the productive ground was found the past season in the west end of the mine. They opened into a branch that gave a length of 90 feet, as wide as the main ore deposit, and it seems to be probable that it will extend up—possibly to the surface. A winze has been started from the surface to come down into this level of the mine, to be used to run down rock.

The mine is now pretty well finished—down to the fourth level—between the fourth and fifth and between the fifth and sixth. In mining the floor in the fifth level they are back stoping the ore and standing on the filling. They are filling between the sixth and the seventh, preparatory to mining the pillars and the floor of the sixth. The great drawback to the work is that there is no lessening to the amount and the cost of the timbering. They are doing just as much work and doing it just as well as ever they did. When they get the mine filled up down to the bottom and are able to dispense with this costly timbering the ore will certainly cost less, even if they do not get it out quite as fast. The company needs the ore and claims to be obliged to adhere to the present method in order to keep up the product. It is expressed as the intention to abandon timbering as soon as the mine is filled, which it is thought will be accomplished when the ninth level is reached, or at the end of 1887.

In the north vein they have mined out all the pillars above the fifth level and the mine has crushed in with the exception of No. 4 shaft, which is sustained by the shaft pillars. During the past year a cross-cut has been driven between the mines, starting from the new downright shaft at the sixth level and intersecting the north mine in its eighth level. East of the cross-cut in the north mine is a body of ore 28 feet wide, 100 feet long, and extending at least to an equal height. One of the purposes for which the cross cut was

made is to be a conduit for the water to the new shaft, where all the water of the mine is pumped to the surface.

The downright shaft is named the Babcock. Above the sixth level the mine is all to the east of it, but below that point it begins to extend west of it also. The shaft is 60 feet south of the ore in the seventh level and in the eighth level it is but 50 feet. The ore body from the second level to the fifth dips about 85° with the horizon; at that point the formation takes a roll to the south and the ore goes down at an angle of 78° .

No. 2 shaft is 350 feet east of the upright. It is in the foot wall and is thus secure, and requires no ore pillars for protection. It dips to the south at 73° , and in the eighth level it is 30 feet north of the ore. It is single skip, and was formerly also used as a pump shaft. Its length is 700 feet. These two shafts divide the mine nicely.

The new pumping machinery, while not sufficient for the water of the mines at a depth of 1,000 feet and more, comprises a double Cornish plunger pump 16"—10 foot stroke. This pumping plant is the duplicate of that at the Norway mine, and designed by the company's master mechanic, Mr. J. B. Lyon. The new pumping engines are 38x28" each. Two hoisting engines, Corliss, each 12x36", two 5 feet drums, Webster, Camp & Lane. The great gear wheel for the pumping engine is 30' 8" diameter.

The new shaft house is 75 feet high, or 85 feet to the ridge, and is covered on the outside with sheet iron. The engine house for pumping and hoisting machinery to the new shaft is just west of it, size, 44x74', with boiler house attached, 52x46'. In the latter are five new boilers, each 16'x56". The new trestle is 40 feet high, and the old one from No. 2 shaft is 78 feet. The new dock has a capacity of 50,000 tons, while the old one is of equal extent.

They have no compressor, but this deficiency will be supplied very soon. The ground is not excessively hard. The rock drifts cost but \$4.50 to \$5.00 per foot, even with hand drills.

The West Vulcan ore is all Bessemer. It ranks with best of the soft blue ore, for which some of the Menominee Range² mines have from the first been noted. It averages about 60% in iron, and .035% in phosphorus. Some analyses give 69% in metallic iron. It is equal to any on the range.

The West Vulcan is not a large mine, as compared to some of our greatest producers, but it is an exceedingly good one. It is concentrated and compact. The ore is mainly in one deposit that holds its uniformity of dimensions. The mine furnishes an annual product of 100,000 tons, and the ore is all Bessemer, and first class.

The force employed consists of an average of 450 men, two-thirds of whom are Italians and Austro-Italians. The superintendent esteems them as quite

faithful workmen. The company has had several years' experience with a large number of men of this nationality, and the officers speak of them in excellent terms. Capt. E. S. Roberts still continues as superintendent at the West Vulcan.

The Vulcan mines were opened in 1877, and have yielded as follows:

Year.	Tons.	Year.	Tons.
1877.....	4,543	1882.....	94,042
187.....	31,239	1883.....	79,874
1879.....	57,350	1884.....	101,722
1880.....	72,405	1885.....	124,120
1881.....	85,671	1886.....	143,930
Total.....			794,836

THE NORWAY MINE

has produced in the last year 93,878 tons of first-class ore, all but 5,000 tons of which were Bessemer. This fact indicates that the mine is not yet exhausted. In truth it is looking well. I have visited the mine twice in the last year and each time I was favorably impressed with the outlook. If they were to mine also this B.B. ore, which is non-Bessemer, the output could be largely increased. In 1880 the yield of the mine was 198,765 tons, and while it is not probable that this product will ever again be reached, the mine is certainly good for an estimate of 100,000 tons annually.

It is a long mine extending from No. 10 shaft, the most westerly one, away up the hill, east a continuous opening, 1940 feet to the east line of the property. They are now drifting west from the bottom of No. 10. At a point 360 feet west a drill hole, which was made, discovered ore. The formation here has a capping of sandstone horizontally hidden; at the west end it is 70 feet thick, gradually thinning to the east, where it is reduced in thickness to ten feet.

The controlling rock in the formation at the Norway and adjacent mines is the limestone. This belt is here in the underlay of the ore and is greatly folded; it sometimes also lays flat and thus cuts out the ore and then again dips abruptly into a deep fold, where a fine deposit of ore is found. Half of the mine, the west half, is open to the sunlight. It is simply a deep, wide synclinal in the limestone, coming down from the north and making a deep fold where the mine is and rising on the opposite side in another fold and again descending, probably passing beneath the swamp to the south.

Were it not for the deep minor folds in this foot wall limestone the store of

ore would be far more quickly exhausted. The many depressions, cavities and folds are filled with ore, and if these are exhausted at one point others are found elsewhere, so that the supply of ore is kept up and no pressing anxiety is felt. Sometimes the limestone is on the south, on the hanging wall side, a fact that in instances led to the supposition that they were north of the limestone. It is pretty well understood now by the miners, who have the intelligence to comprehend the matter, that this anomalous position is due to the folding in the formation. The ore is found in pockets and these occur with much irregularity, affording strong inducement to search with a constant expectation of success.

No. 10 shaft, the west one, was sunk 135 feet through the sand rock and soap stone and a cross-cut made south 100 feet to the limestone. Recently they have made a rise in this cross-cut and found ore. The ore was first encountered by a drill boring near the shaft and its position with reference to the cross-cut conjectured, so that the rise was made to verify the supposition. The ore lies on the soap rock and they have it, 20 feet wide, where they are now stopping. It has been but recently found and seems to curve to the south, following the folds of the formation.

From No. 8 pit, further east, a drift has been made west which comes into this same deposit of ore. From No. 6 to No. 10, a distance of 900 feet, the mine is practically all open cut. The ore in this end is all Bessemer. The workings are wide and irregular, for a long distance extending to a depth and width of a hundred feet. No. 8 pit is perhaps the deepest and widest pit, and thence on to No. 5, where the mine is all underground. The underground portion of the mine has a length of 1,000 feet from No. 6 pit to the east line. But little has been done here for two years past. The mine has been all the time partially full of water, waiting for the time until the new machinery, the new shaft and the water adit from the south should be completed, when it could be pumped out. The mine is no deeper than it was five years ago; when the Penn. Co. bought it it was thoroughly opened. There was a great amount of stoping ground ready to work and since that time the company has been able to keep up its product without sinking a foot.

The Norway mine has been worked out in very large chambers. The ore and the jasper formation in which it occurs stand remarkably well. The ore yet remaining in the mine is mostly the B. B., or Stephenson ore, as they designate it, but when relieved of the water and they can again work in the bottom, another level will be opened. The occasion of the condition of this part of the mine was, as explained in my last report, due to the caving in of the east end. About 300 feet in length of the part next to the Perkins went in from the top to the fourth level, leaving the fifth level still intact. It is plain to see that this underground opening must take all the water from the west end

of the Norway, and also a still greater amount coming from the east from the Perkins and Stephenson mines, which are in condition to gather a great deal of water. There is not much water in the mine now, only at the bottom level. It would have been all out ere this had it not been for a break in the gear of the pump. They are having a steel gear-wheel made which it is assumed will endure the strain that one of iron has proved unequal to sustain. The pumping plant is the counterpart of that at the West Vulcan, double acting pump, 16" plungers, 10' stroke, discharge pipes between the rods, one plunger rises as the other descends and the flow of water is constant. The machinery is in a new stone engine-house which is 40x100'. The big gear-wheel between the engines, to which the rods are attached, is 30' 8" in diameter. The engines are low pressure, each 28x38". Also two new boilers 18' by 72". They are still using but one plunger, for the reason that the water was cut in the drift from the new shaft, and thus came in flooding the bottom before pumps were ready for it. They have been using a 10" plunger as a substitute in relieving the mine of the water, and it is the gear-wheel of this latter that is broken.

In the level ground below the hill, just east of the new stone engine house, a downright shaft has been sunk and through this all the water of the mine will be raised. It is pumped up to within 100 feet of the top when it runs off through an adit 1,200 feet in length, driven up from the south.

The new shaft is 9'x16', single cage, but divided into four compartments. It is down 25 feet below the sixth level, which latter is 355 feet from the collar of shaft.

A cross-cut has been made from the shaft, at a point 270 feet down, to the fifth level and they are also engaged in driving one from the sixth level to the shaft, which will be 150 feet in length, the bottom of the shaft being that distance south of the vein. Old No. 3 shaft in this part of the mine is still used, but there is a liability of its going in some time, and in anticipation of such a contingency they are raising up in an old shaft north of No. 3, securing it with rock, so if No. 3 gives way they will have this one to fall back on.

They are also sinking a new shaft, to be a permanent one; it is located 100 feet from the west line and is sinking wholly in the foot wall, where it will be entirely safe whatever may happen in the mine. From this they can explore the old workings, take out the pillars of ore that are left, can sink deeper and go under the whole and all the while have a line of exit, etc., that no collapse can injure. There is much good ore in the pillars still, which will be ultimately secured. The sixth level also, although partially opened, has not been stoped in to much extent. In the fifth level at least one-half of the ore is standing. A stretch of ground 500 feet in length is yet untouched. There-

are two lenses in this part of the mine. The south is Bessemer, the north vein is the B. B. or Stephenson ore. As previously stated, the latter quality of ore predominates in the east part of the mine; at least it comprises the major part of what is now standing in the stopes.

During the past year there were about 5,000 tons of this B. B. ore mixed with the Bessemer and still the mixture was kept within the limits for steel making. The product the first year has been taken from Nos. 3, 5, 8, and 9. In No. 3 the ore comes from some pillars that were removed. Also about 10,000 tons were taken from the shallow pit just northwest from the office, adjoining the Cyclops. There is some ore in this pit still in the bottom, but it is not clean, not wholly free from rock, nevertheless it will afford some ore still. It would seem to be good ground to explore east of this pit and also south. No doubt there are other "finds" to be made that may prove equally as valuable as this has been.

No. 8 pit furnished 20,000 tons of the product of 1886. The product of the Norway for each year is as follows:

Year.	Tons.	Year.	Tons.
1878.....	7,533	1883.....	114,836
1879.....	73,540	1884.....	71,515
1880.....	198,765	1885.....	57,741
1881.....	137,558	1886.....	93,878
1882.....	165,084		
Total.....			919,620

The working force consists of 320 men, including those working at the Cyclops. The men are mostly Swedes, and are pronounced by the officers as being a first rate class of workmen. The best of feeling seems to exist between the officers of the mine and the men.

The Superintendent, Capt. John Oliver, has all the requisites of a capable mining man, including the ability to direct with advantage a large force of men.

Of the

CYCLOPS MINE

there is just now but little to be said. Capt. Oliver is trying to find some ore, and, unless he succeeds in developing something to advantage beyond what now appears, the mine is not likely to produce much in excess of about 5,000 tons in 1887. In Dec. the product was but 518 tons. They have small amounts of

ore in several places but no large body of it in sight anywhere, and they have as yet no knowledge of the existence of any. However, five years ago, when the Penn Co. purchased these mines, the Cyclops was rated as of little value. It looked as unpromising then as it does now, but it has since produced 164,391 tons of the finest ore, probably the cheapest ore that the company has obtained in any of its mines. It has been a standing remark that the profit on the Cyclops ore has served to even up the excessive cost of some of the ores obtained elsewhere. The Cyclops joins the Norway on the west, but it has never been an expensive mine, very little machinery or other plant has ever been required. The simplest outfit is all that has been necessary to secure the ore. Just now some exploring work is in progress and other important "finds" may be made.

Capt. John Oliver superintends the operations at this mine also. It is so near the Norway that the two mines are practically one and the same thing.

The following table shows the yearly product:

Year.	Tons.	Year.	Tons.
1878.....	6,275	1883.....	22,675
1879.....	46,442	1884.....	24,099
1880.....	14,368	1885.....	49,897
1881.....	12,214	1886.....	37,189
1882.....	18,287		
Total.....			231,476

The only other mine owned by the Penn Company is

THE QUINNESEC,

which was formerly one of the important mines of the "Range." It is an underground pit 500 feet deep, and of an equal length, but practically an exhausted mine. In fact, the mine was abandoned two years ago. The pumps were taken out and the mine filled with water. Subsequently an examination by Capt. Oliver resulted in a partial resumption of mining work, and a product of about 14,000 tons of ore has been obtained each year since. This ore has been mainly derived from the pillars, floors, and from behind the lagging. However, there is not much more to be got from these sources; probably 5,000 or 6,000 tons will constitute the product for 1887—got from old No. 3 shaft, at the west end of the mine. They have only worked down to the third level; below that the mine is filled with water. They are pumping it out to get down to the fourth level, as there are some pillars left between the third and fourth levels at No. 3 shaft.

Some years ago the Menominee Mining Company, the former owner of this mine, bored a hole 266 feet deep at a point 235 feet west of No. 4 shaft, and claimed to have found 25 feet of ore. Recently the Penn Company has driven to this one from No. 4, and at the time of my visit they had just got into it. They were too near the sandstone capping, however, and the ore as found was not of a marketable quality. It may prove better when further developed.

The Quinnesec mine has produced as follows:

Year.	Tons.	Year.	Tons.
1878.....	26,467	1883.....	21,676
1879.....	42,127	1884.....	16,994
1880.....	52,357	1885.....	14,101
1881.....	43,606	1886.....	13,442
1882.....	44,240		
Total.....			274,719

The Penn Company is exploring west of the Ludington mine, on the N. E. $\frac{1}{4}$ S. W. $\frac{1}{4}$ of section 25, T. 25, R. 34. They have sunk 235 feet, and have driven north and encountered limestone. Have also drifted south 225 feet, and come to quartzite, then into lean ore formation, in which they are now drifting, January 1, 1887. The shaft is 80 rods south from the old Ludington.

THE PERKINS MINE.

A year ago when I visited this mine I found them engaged in removing the machinery preparatory to abandoning the property. It had been held since 1879 by the Saginaw Mining Co., by whom it had been continuously worked up to the close of 1885. The mine was declared to be exhausted, with the exception of a few ore pillars that it would be a matter of much difficulty to obtain. The Stephenson mine, which lies north of it, in the foot wall of the Perkins, had caved in and this collapse had also carried down the latter with it. The mine was a total wreck. All the levels and the shafts were in ruin. The machinery was nearly all gone. Thus altogether it was about as forbidding a location as one ever saw. When it was said that Capt. Perkins was going to work the mine as a personal venture, it was generally thought to be an unpromising undertaking. However, after the lease was given up by the Saginaw company, Capt. Perkins obtained possession of the property and has been working the mine on his own responsibility during the past year, and has succeeded in mining and shipping 12,856 tons of first class ore.

It must be remembered that Capt. Perkins has had charge of the mine since

it was first opened, seven years ago, and thus was entirely familiar with the situation. He knew the exact position of all the ore pillars that remained, and was able to conjecture as to the probability of the continuance of the ore body in any portion of the mine—information that, under the circumstances, was of much pecuniary value.

He has sunk in the "crush" at the west end down into the old workings, and it is here in the west end along the north line of the property that he has obtained the ore. It was really much safer to work here now than before the mine had crushed in. Before that it was dangerous, impracticable to do further work. The constant liability to crush in made it unsafe. Now it is all right. They can advance with confidence through the crushed ground, merely necessary to timber the openings which are made. In the west shaft from the surface down to the bottom of the open pit it is 44 feet, and thence to the bottom of the slope it is 141 feet. Capt. Perkins has opened two levels to the west and is stopping in both. He is also drifting east from the bottom in the direction of a shaft that he has sunk through the crushed bottom at a point about midway from the east and west limits of the old mine. The drift follows the ore.

He is prepared to hoist from the two shafts, and estimates the product for the coming year at 15,000 tons. I am inclined to think that it will exceed that amount. The ore is of two varieties, yielding on the average about 58 % in iron and within the Bessemer limits in phosphorus. It was mainly sold to the Cleveland Rolling mill, and was worth in Cleveland about \$5,000.

There are two new hoisting drums (W. C. & Lane) four feet in diameter. No pumps are required, as all the water drains into the Norway. The mines have been worked to about the same depth; but Capt. Perkins has not yet gone to the bottom. He employs about 30 men. The bottom of the mine is limestone, which comes down from the north, back of the Stephenson, and forms a synclinal, or fold, and then dips beneath the swamp to the south.

The Perkins mine cannot be ever again, in this part of it at least, a large producer, but it is likely to prove a pretty profitable undertaking for the present proprietor.

The yearly product of the Perkins has been as follows:

Year.	Tons.	Year.	Tons.
1874.....	13,492	1883.....	76,514
1880.....	49,433	1884.....	38,120
1881.....	60,706	1885.....	18,023
1882.....	73,648	1886.....	12,856
Total.....			342,786

The estate comprises the S. W. $\frac{1}{4}$ S. W. $\frac{1}{4}$ section 4, T. 39, R. 29, situated in the village of Norway, Mich.

CAPT. JOHN PERKINS,
Manager.

THE STEPHENSON MINING CO.

is a new organization recently made to operate the Stephenson mine which adjoins the Perkins and the Norway. It is owned by the Lumberman's Mining Co., and was opened in 1879 and was worked up to 1882, when it closed down for the reason that all the available ore, it was deemed, had been taken out. There was some ore left in the pillars, etc., which could not at that time be reached with safety. Since then the mine has fallen in, as have also the old workings of the Perkins mine, which, in a measure, rested upon it. Some gentlemen in the vicinity, noting the success of Capt. Perkins as previously explained, leased the Stephenson property and have sunk through the crush north of the west shaft in the Perkins and have shipped 1,018 tons of ore besides having a like amount in stock at the mine. The shaft at the time of my visit (Jan'y 6) was down 100 feet and they were mining and hoisting about 25 tons per day, working a force of 25 men. They had two small hoisting drums of a very ancient pattern that were very inadequate to rapid work. In the mine they had a run of ore about 75 feet in length and 20 feet wide. The mine is in the foot wall side of the Perkins and the formation, including the ore deposits, is governed by the limestone which is much contorted and folded, so that instead of dipping south it is folded back so as to dip north. Something of this kind appears in the Stephenson, the ore, which would speedily go to the Perkins by crossing the boundary line if it continued dipping south, is found to widen out and grow larger through the northerly inclination of the walls. The ore is of two varieties, Bessemer and the Norway B.B. ore. The work is in charge of Benj. Tretheway. Though not much can be accomplished until some expenditure is made to procure machinery with which to hoist. Of course there is no water to pump, as it all drains into the Norway. The officers are N. A. Phillips, Prest., Chicago; J. Bergeron, Treas., Norway; H. G. Fisk, Gen'l Manager, Iron Mountain, Mich.

An analysis of the ore recently made gave 63% in iron .040% phosphorus. Though of course this by no means can represent the average of what they are now mining. The estate comprises the N. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$, S 4, T. 39, R. 29, and the yearly product has been as follows:

Year.	Tons.	Year.	Tons.
1879.....	798	1881.....	10,856
1880.....	23,341	1886.....	1,018
Total.....			96,013

It is reported that the mine, or a controlling interest in it, has been sold in Milwaukee for \$100,000, or at that rate.

THE CURRY MINE

which adjoins the West Vulcan on the west and being in the N. E. $\frac{1}{4}$, N. E. $\frac{1}{4}$, S. 9, T. 34, R. 29, has been wholly idle during the past year. There is a lense of soft blue ore that pitches to the west rapidly, the dip being south. The bottom is now so far from the shaft that it has become expensive mining.

Controlling interest is held by J. H. Outhwaite, Cleveland, Ohio.

The mine has produced as follows :

Year.	Tons.	Year.	Tons.
1879.....	13,010	1883.....	3,676
1880.....	21,741	1884.....	10,074
1881.....	17,504	1885.....	4,897
1882.....	13,374		
Total.....			84,281

THE BRIAR HILL MINE

joins the Curry on the west and is very similar, having a limited lense of soft blue ore. The proprietors are Youngstown, Ohio, capitalists, the owners also of the Iron River, Youngstown, etc., mines. It is the best of ore, the only drawback is the limited quantity. The mine was worked two years and yielded an average product of 14,982 tons.

THE INDIANA MINE

was shut down last summer. Some of the personal property was seized and advertised to be sold at sheriff's sale.

The mine is a wet one and the ore has never developed in quantity sufficiently to make the undertaking a success.

The estate is the N. E. $\frac{1}{4}$, S. 27, T. 40, R. 30.

The President and General Manager of the Indiana Iron Mining Co. was R. P. Travers, of Chicago, though it is reported that the mine has changed hands. The product for each year has been as follows:

Year.	Tons.	Year.	Tons.
1882.....	4,280	1885.....	2,738
1883.....	4,360	1886.....	5,854
1884.....	638		
Total.....			17,871

The officer in charge of the mine is Capt. James Waters, and it is reported that work will be again renewed soon.

THE CHAPIN MINING COMPANY.

No finer body of ore has ever been found in the State than the Chapin. It is so large, of such uniformity, of such excellent quality, so easily broken in the mine, so fully tested, with no diminution, that it certainly is not excelled, if equalled, by any other deposit that has ever been found in the Lake Superior region.

But with all its great advantages the mine has not attained the success that even many lesser concerns have met with. The method of mining originally adopted and until recently adhered to has proved unfortunate. The company has been forced to abandon it utterly and to pursue a wholly different plan, in fact to open a new mine underneath the former one at a great expense. It is also forced to resort to expedients to obtain the ore remaining in the old openings that of necessity add to the cost of it. Some of this ore also will never be obtained.

Portions of the mine have caved in and the ore has in a measure become mixed with the overlying sand and gravel so as to render it valueless.

The old method of mining was fully described in my last and previous reports and the difficulties that had been encountered were also sufficiently explained, it thus only remains to describe the operations for the past year.

The Chapin mine, as is well known, is a wide deposit of ore trending east and west and dipping to the north. It lies in the hill that slopes to the north and west to the low land, which was originally a cedar swamp, and on the opposite side of which the land again rises. In the opposite slope on the west side of the swamp is the Ludington mine. The easterly portion of the Chapin

is up on the top of the hill, while the west end is in the low swamp level. The magnetic bearing of the westerly portion of the ore deposit is north, 70° west, and thence east the bearing is nearly east and west.

It forms a long curve, with the concave side to the north. The foot wall of the ore is on the south side and the hanging wall of winze on the north. The angle of the dip varies from 65° , with the horizon at the east end to 80° and 85° at the west end.

The maximum length of the mine is 2,400 feet, and at the east end there are two parallel deposits called respectively the north and south deposits. The latter is the main one. The north deposit is relatively so small compared to the other that it is little considered in estimating the mine. This deposit, as does the other also, pitches to the west at an angle of about 30° , and as the deposit widens in its descent into the earth each successive level increases in length. In the first level the ore gave a length of 150 feet, but each level has regularly increased, so the sixth is 600 feet in length. This lengthening has gone on more rapidly since the fourth level by reason of the foot of the lense going down more sharply than the hanging. The average width of this north deposit in the sixth level is 45 feet for a length of 520 feet, the maximum width being 100 feet. The ore is choice; there is no jasper in it. It is not only lengthening but widening also, since in the level above it only averaged about 30 feet in width.

The main ore body also has a westerly pitch; its average dimensions at right angles to the axis is 1,000 feet. Its average width, in the fifth level for instance, is 55 feet for a length of 1,500 feet of entirely clean ore. The sixth level is not fully opened yet, but possibly it may be found to narrow slightly, to tend to wedge out as the north deposit wedges in, *i. e.*, it may be that as the north deposit seems to be set with its small end up, the south one has the reverse of this position.

The east end of the mine has greatly improved in the past year through the fact that a fine deposit of ore was found which was heretofore unknown. It was worked in the third, fourth, and fifth levels, giving in each a length of 150 feet, and an average width of 20 feet. In the sixth it has not been largely opened yet, but it is found to continue all right. They have mined out all the ore the full width of the deposit and filled the room with rock. They fill up, lay a floor on the filling, and back stope the ore, causing it to fall on the floor, where it is gathered up and sent to the shaft. This small deposit being so short and narrow as compared with other portions of the mine, they are able to take out the ore without observing such precautions as are requisite elsewhere.

From the fifth level up the greater portion of the pillars are still standing.

Between No. 6 and No. 7 shafts in the fifth level the ore has been mostly all taken out and the mine filled, and west from No. 6 to No. 5 many of the pillars are gone. Still there is a great deal of ore left in the mine in these pillars; actual estimate shows it to be 8,712,000 cubic feet or 871,200 tons of ore. This is the amount of ore still in the pillars above the fifth level and exclusive of the "caves." How much of it will be got out is a question; but I judge that most of it will be, practically all of it. If they continue to work systematically and fill in between the pillars before disturbing them, get the mine filled up, make it all solid and safe, then they can attack the pillars with perfect confidence.

A year ago, when I was previously in the mine, they were working at some pillars, rising up in them—undercutting them and filling—but it had to be abandoned, the ground would not stand. That method can be followed if the rooms between are filled clear up to the top. Then they can rise up and back stope the pillars and fill in as they advance.

The buildings which stood over the mine have all been removed, and to a considerable length over the widest part of the deposit they have stripped the ore and run the dirt, etc., down for filling and are now mining the pillars underhand in open cut, hoisting with derricks and buckets. This work will be continued at least through the winter while the ground is frozen. It is probable that in this way the pillars can be mined out down to the second and possibly to the third level. I do not know that it is the present intention to continue this work so far down as that, but it could be done where the vein is so wide and the walls stand so upright. They have nearly ceased to hoist in the old shafts; a little is yet done in No. 7, but will be discontinued in a few weeks.

Some account has to be made of the water at the Chapin, it is so large a mine; but they have always kept it well opened ahead, so that the ore would be dry. The water is taken through the fifth level to the pump shaft in the east end of the mine where is the pumping machinery operating four plungers, two 12" and two 17", 200 feet "lifts," 10 feet stroke. The plungers alternate, that is in the second 200 feet lift a 12" plunger works opposite a 17", the positions being reversed from what they are in the first lift from the surface. From the sixth level the water is raised with steam pumps to the fifth. The mine is well supplied with large steam pumps to take the water in case of accident to the plungers. One is a Wells pump, 13"x14", and the others are two No. 12 Camerons.

The new plans have assumed shape, and instead of stating as I did a year ago what it was proposed to do, we may now describe what they are doing—a system that is in actual operation.

The two new vertical shafts—sunk in the hanging wall—are down to the sixth level, the bottom of the mine. They are sinking to the seventh. B shaft is 1,050 feet from the west end of the mine, and is 240 feet deep. C shaft, 775 feet west of the former, is in lower ground, and thus is only 374 feet deep to the same horizon at the bottom. These shafts are each 9'x12' inside the timbers, and each is double cage, pump ladder way, etc. 1 $\frac{3}{8}$ " steel wire rope is used for hoist.

Each engine house is of stone—sandstone found on the location. C engine house is 49'x117', including space for electric light engine, and for four boilers each 5'x16'.

B engine house is 49'x77'. The walls are heavy and start from the solid ledge. In each house is a double hoisting drum for operating the cages. Each is 10 $\frac{1}{2}$ ' diameter at the ends, and 14 $\frac{1}{2}$ feet in the middle. Thus each one is "coned" from the ends to the center, and thus are 10 foot face, *i. e.*, 5 feet from center each way. They were built by the Bullock Manufacturing Company, and can be locked instantly, to work together, or be with equal facility thrown apart to work separately.

In this particular they are an advance upon any similar machinery in use in the mining region. They have the Lane band friction. The most striking improvement being the facility with which either engine may be thrown out of gear to work either half of the drum separately.

The cages work with great rapidity, smoothness, and freedom from danger. The automatic safety clutches afford ultimate security in case of accident. The ascent is made in $\frac{1}{2}$ a minute, or even in less time.

Each shaft has a capacity of 1,000 tons per day, without especial crowding. Each engine house is near its shaft, just north of it, and along on the south side is the fine new ore dock, which is 1,000 feet long, raised to the proper height above the railroad by a wall of sandstone laid in masonry.

B shaft at the fifth level is 120 feet north of the ore, and C is 275 feet at the same depth. The latter is in the limestone, which at the Chapin overlies the ore. It will continue in this for two "lifts" more before the dip of the formation carries it north of the shaft.

Cross-cuts from each shaft have been made to the ore in the third, fifth and sixth levels. It was the plan to connect these cross-cuts by drifts in the hanging, driven along about 20 feet from the ore. But the results of such a drift made in the sixth level have demonstrated the non-feasibility of this plan. The ground will not admit of it, it crushes in. The drift is timbered, but the timbers are all out of shape and cracked and broken, the effects of the pressure in the hanging rock.

Drifts in the hanging wall have therefore been abandoned, and the method

resorted to in its stead is to cross the ore body and make the connecting drifts in the foot wall. In the sixth level at C shaft a cross drift through the ore has just been made, 7'x8', and built of masonry—sandstone blocks laid in cement mortar. It is, of course, arched and made very substantial to withstand any possible pressure which future exigencies may require. The masonry only reaches through the ore which here is 62½ feet.

The longitudinal drift is making in the foot wall just in from the ore; at each 50 ft. space along the main drift ore chutes will be made, and at intervals of 100 feet will be located the rock mills for running down material for filling. These rock mills are made circular, 2½ feet in diameter; they are built up of blocks made after a pattern, at the mill, being cut out with the saw. They are thus practically indestructible, as the blocks are held in place by the filling which surrounds them, and the descending rock through the mill impinges against the ends of the blocks.

The method of mining will vary according to the conditions met with in different parts of the mine; where the ore body is very wide they make a drift through the ore at each 50 feet and stope each way from these crossings, filling in behind with rock up to the back, blocking up to make all firm. The stope is carried about 7 feet high. When a section of the ore body is thus removed another rise is made and a second section is mined, the ore falling upon the filling, which is covered to receive it. The advance is made in the same way as before, by filling behind up to the back of the stope. As they rise the ore is run down through the chutes below and the rock comes down from above through the mills.

Timbering is wholly abandoned; hereafter wherever ore is extracted the space will be filled with sand and rock. The ore will be all taken out.

A third shaft is to be sunk—D. It will have to be in the low, wet ground where it is 100 feet to the ledge, and it is likely to be a matter of much difficulty to reach it. The point selected for this shaft is 1,100 feet west of C and 600 feet from the west line of the property, but it is on the south side of the ore, on the foot wall side. It is in contemplation to freeze the ground in sinking the shaft. This course is pursued in Europe but has not, I think, been resorted to in this country. The work of sinking the shaft will be begun in the spring.

The new hoisting engines are 30"x60"—four of them. They are run by compressed air brought in pipe from the hydraulic works at the Quinnesec falls, but steam is provided and can quickly be resorted to, to furnish the power in case of accident to the water-works, etc. The average speed of the compressors for the year was 29.4 revolutions per minute. Average pressure 60.8 pounds per square inch, and produced during the year 1,826,744 cubic feet of

air of 60.8 pounds pressure. This for the 3 pairs of compressors at the hydraulic works. The Chapin mine is thus fully equipped with double power—water and steam—either sufficient to operate all the machines.

They have an abundance of filling material in the sand stone ledge on the high ground at the east end of the property; it is easily quarried and transported to the shafts. At present they are using the dirt also that deeply overlies the ore.

It should be remarked that D shaft, when completed, will be also double cage, etc., and in addition will be the pump shaft; the water will go to the west end of the mine instead of at the east end as now. It is intended to make it 21' diameter to the ledge.

The tram cars in the main halls will be run by wire rope, the machinery for operating which will be placed in the cross-cuts near the shafts.

It may also be said that a fourth pair of compressors will soon be supplied at the hydraulic works—36"x60"—the others are all 32"x60".

There will be in stock at the mine at the opening of navigation in the spring 80,000 tons of ore, and the coming year's product will not fall short of 250,000 tons.

The ore is all the beautiful soft blue ore so greatly prized by the makers of Bessemer pig metal. It averages above 60% in iron and within the Bessemer limit in phosphorus. It sold in Cleveland the last year at an average of \$5.20 per ton.

The Chapin has heretofore been controlled by the Menominee Mining Co., but recently a new organization has been made to operate this mine,—The Chapin Mining Co.

About 800 men are employed.

John H. Van Dyke, Vice Pres., office Milwaukee, Wis. The local officers remain as heretofore: C. H. Cady, Supt., Iron Mountain, Mich.; Wm. Oliver, Mining Capt.; Per Larsson, Mining Eng., etc.

The annual product of the Chapin has been as follows:

Year.	Tons.	Year.	Tons.
1880.....	34,556	1884.....	290,865
1881.....	134,717	1885.....	177,978
1882.....	247,505	1886.....	198,871
1883.....	265,830		
Total.....			1,350,322

ANNUAL REPORT OF THE
THE HEWITT MINING COMPANY.

Close to the Chapin at the west end and in its foot-wall is the Hewitt mine. The company has mined for several years in several small lenses of ore, which are now practically exhausted. At the time I last visited the mine—in December—there were a few miners at work in the mine, and they were also sinking a test shaft over the hill to the south of the mine, which had just reached the ledge. It was understood that unless something should be found of more promise than was at that time apparent, the mine would be soon shut down. The location is in the N. W. $\frac{1}{4}$ N. E. $\frac{1}{4}$ S. 41, T. 40, R. 30. C. H. Jones, Sec. and Treas., Menominee, Mich.; W. P. Bice, Mining Capt., Iron Mountain, Mich.

The annual product of the Hewitt has been as follows:

Year.	Tons.	Year.	Tons.
1881.....	4,352	1884.....	7,927
1882.....	9,677	1885.....	4,627
1883.....	7,516	1886.....	5,517
Total.....			39,606

THE LUMBERMAN'S MINING COMPANY.

Across the valley in plain view from the Chapin is the Ludington mine, which for a few years past has been a large producer of first class ore. The product in 1886 shows quite a falling off from the previous year's output, but this shortage was due to the crippling of the hoisting facilities, to the caving in of the mine which occurred in September last.

This fall of ground took in No. 1 shaft and reached down to the second level, but the company caused it to extend to the fifth level for safety. Its area covered about 100 feet square of the mine—about the extent of three rooms. They are making no change in the plan of working the mine. The ore is mined out in rooms, leaving pillars of ore between, and the rooms are timbered, after the western system, using heavy timbers placed in sets, frequently heretofore described. To get out the large product which the Ludington has been made to furnish, has caused the mine to deepen rapidly, and the recent catastrophe has illustrated the fact that this cannot go on indefinitely with safety.

At the east end of the mine where the crush occurred the ore body is very wide—80 to 90 feet maximum—but at the west end it is split in two by a horse

of rock that has continued down from the surface, and this pillar helps greatly to support the mine.

Just now they have two working shafts, the downright and No. 5. They are rising up in No. 1 through the crush, and will also soon be ready to hoist again in that shaft.

It is all safe again for a time, being solid down to the fifth level.

Above the fifth level the ore is in pillars, and below, in the sixth, not much mining has been done. They have this ore for the coming year's stoping.

No. 5 shaft is in the north branch of the ore deposit. At the west end it is to the bottom, to the sixth level, 525 feet deep from collar of shaft to bottom; it is single skip. Its distance from the south end of the cross-cut at A shaft is 290 feet.

The vertical—A shaft—is in the hanging wall, 175 feet from the ore at the bottom. It is 500 feet deep, 300 feet of the distance being in limestone. The shaft is sinking to the seventh level. It is double cage and also the pump shaft. The sixth level is but 470 feet from the collar of A shaft.

The cages are each $4\frac{1}{2}' \times 5\frac{1}{2}'$. They are now—December—putting in rods for the pumps in A shaft. The plungers are 18" and 9 feet stroke. Five strokes per minute will take all the water of the mine. I judge that the mine looks just as favorable as it did one year ago. It is not as easy to get about in the mine underground, owing to the fact that the connections are not fully made with all parts of the mine and the new shaft as yet. The ore is reached from the A shaft through a long cross-cut in the sixth level. The length of the mine east and west is 800 feet. It is lengthening somewhat to the west on the inclination of the lense. The dip is slightly to the north, but the ore lense also inclines to the west, and widens out as it descends in that direction. The average width in the fifth level of the ore body is about 60 feet, being about 40 feet in the narrowest place. They make two grades of the ore, the distinction being the amount of phosphorus contained. About 40% of the product is Bessemer. The non-Bessemer runs about .085% in phosphorus, and above 60% in iron.

An analysis recently made of a collection of samples of Ludington ore gave:

Dried at.....	210° temperature
Metallic iron.....	67.10%
Phosphorus.....	.033%
Silica.....	1.88%

The average price at which it sold in Cleveland was \$4.87.

The Milwaukee & Northern R. R. Co. is building its track along by No. 5 shaft, and a large ore pocket will be erected to discharge into its cars. Also

the C. & N. W. R. W. Co. is grading its track so as to come under a large double pocket at A shaft. The Milwaukee & Northern will be provided with large twenty ton cars for transporting ore, *i. e.*, cars which will hold twenty tons.

No. 1 shaft will be used mainly for letting down timber into the mine—800,000 feet of timber—or, including lagging, 1,200,000 feet are used annually in the mine.

The Ludington is now one of the best equipped mines, in the matter of machinery, in the State. The fine new engine house, founded on the solid ledge and built of sandstone, with iron roof, has been fully completed; it is 110x50 feet. The hoisting machinery comprises four drums—W. C. & Lane—each 12' diameter. The wire hoisting rope is 1½" diameter. The engines are two—Hamilton Corliss 24"x48", also electric light engine and five new boilers. It cannot burn up, for all is of stone and iron. As with the Chapin, the power is compressed air, furnished from the hydraulic works. The engines and boilers are ready to be used in an emergency.

The company employs 250 men now.

They are working in the old Ludington also, which is 906 feet west of No. 5 shaft. It is called old No. 2. Work was begun here in November last. They have a deposit of Bessemer ore about six feet wide and are down below the surface 130 feet. The difference in the surface level between it and No. 5 shaft is 30 feet. This No. 2 shaft is operated with a four foot Rochester hoisting drum.

The officers remain without change; Geo. E. Stockbridge, Gen'l Manager; A. D. Moore, Supt., Iron Mountain, Mich.; Henry Davis, Mining Capt.

The Ludington mine has annually produced as follows:

Year.	Tons.	Year.	Tons.
1880.....	8,876	1884.....	101,165
1881.....	3,365	1885.....	124,194
1882.....	52,519	1886.....	76,983
1883.....	102,632		
Total.....			469,734

The mine is in the northeast corner of the S. ½, S. E. ¼, S. 25, T. 40, R. 31.

THE HAMILTON ORE COMPANY

is the corporate name assumed by the company that is sinking the shaft adjacent to the Ludington and Chapin mines.

The location of this celebrated shaft is 40 feet from the Ludington line, in the S. W. cor. of the N. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$, Sec. 30, T. 40, R. 31. The Chapin mine on the south and the Ludington on the west. The remarkable feature about this shaft is that it was undertaken with the full knowledge that it would have to be sunk 800 feet before the ore would be found. The purpose was of course to intercept the Chapin and Ludington deposits in their underlay on the Emmet company's property.

The work of sinking was begun four years ago, and this year the shaft appears in the list of producers. The shaft is 9'x12' inside the timbers and is timbered to the bottom, 960 feet from the collar, vertically down. Several drifts were made from the shaft on the way down. At 440' from top they drifted to the north 30 feet and south 80 feet, both in jasper. At 580 feet a drift was made south 60 feet, also jasper. At 843 feet a drift south 100 feet was in ore the south 20 feet. At the bottom the shaft is in ore and a diamond drill boring was made 225 feet in the direction of the dip of the formation. The boring is said to have been all in ore. Mr. Foster estimates the width of the ore at bottom at 100 feet.

At the present writing the shaft is idle, work having temporarily ceased a few weeks ago. I was told that Mr. Kimberly was east negotiating for a plant of machinery that would be adequate not only for sinking the shaft but to open a mine and to resume mining work on a large scale. I understand that there is an immediate necessity for more powerful pumping machinery in order to prosecute the work of sinking, etc., to advantage.

The Hamilton shaft has been a good exploration for the Chapin company, since it demonstrates the continuance of the ore far below the bottom of that mine. The Chapin people have the assurance of the continuance of the ore body to at least twice the depth to which they have penetrated in it.

It is probable that during the coming year efforts will be made to equip this new shaft to open up a mine and to make it a producer of ore in considerable quantity. At least such it is declared, by those in charge, is the design.

Eight hundred and seventy-two tons of ore were shipped from the mine in 1886.

P. L. Kimberly, V. P., Cleveland, Ohio; R. Williamson, Sec. and Treas., Chicago, Ill.; E. T. Foster, Agt., Iron Mountain, Mich.

THE CORNELL IRON MINING CO.

The Cornell mine, about a mile and-a-half from Iron Mountain, has been worked in a moderate way for a year past by the new company. The old mine, opened and worked six years ago, consisted of an open pit about 300 feet long and

60 feet wide and of an average depth of about 60 feet. Mr. Friedrich, the superintendent of the company, began work at the northeast corner and also in the southwest corner. The trouble is that the ore is not concentrated; the formation is banded; that is, the ore alternates with belts of soap rock, both of about an equal thickness, but never wide enough to be mined to advantage or with profit. The formation bears about N. 55° W. and dips southerly. The same peculiarity is observable across the bottom of the pit—ore and rock in succeeding layers. In the east end, where they are now stoping, at about 50 feet below the surface, they have good ore, but it is only 2 or 3 feet wide where there is rock and again ore; they have mined ore along the north side of the pit by separating it thus from intervening rock. They hope by driving further north and east to find ore in greater body. There is ore enough if it were concentrated together. Possibly it will be found to be so at greater depth. Their plan is to drift in northeast across the formation and then "open out."

At the southwest corner of the pit, or a little southwest of that end of it, they are sinking a shaft; are down 120 feet. They drifted west from bottom of the pit 50 feet and sunk a winze 70 feet.

The ore so far is proved to a depth of about 100 feet and a length of 150 feet, showing a width of 8' to 12 feet.

The shaft is going down so as to reach this ore in the west end; when it is completed they will be ready to mine and hoist ore. So far the ore has been taken from the east end and the sides of the open pit:

The ore is of fair quality; as a whole, it is non-Bessemer, though samples have been analyzed, which placed the ore within the Bessemer limit. A branch of the C. & N. W. R. W. Co. extends to the location and the mining company has reasonably good facilities for handling ore. The machinery consists of three hoisting drums, two of them 4' diameter and one 3 feet, with the requisite power to operate them. The officers are: President, Joseph Flesheim; Hugh McLaughlin, Secretary; P. A. Van Berger, Treasurer; John Freidrich, Superintendent, Iron Mountain, Mich.

The description of the property is the E. $\frac{1}{2}$ N. W. $\frac{1}{4}$ S. 20, T. 40, R. 30. The mine was worked three years, producing in

1880	30,856
1881	11,816
1886	4,566
<hr/>	
47,238 tons.	

THE ANDERSON.

Near the Cornell a party of Swedes is engaged in sinking a shaft; are down about 100 feet, but at the time of my visit they did not have ore.

TRADERS' MINING CO.

is an organization made to develop and work a property near the Cornell, being S. $\frac{1}{2}$ S. W. $\frac{1}{4}$, S. 17, T. 40, R. 30. There is an iron formation extending from Lake Fumeé in section 26 northwest through sections 27, 21, 20, 17, 18, in which a good deal of exploring has been done. The only working mines that have ever been opened in it are the Indiana and the Cornell, and these have not thus far developed any great quantity of ore or proved profitable mines. The Traders is in this ore belt. The ground has been a good deal explored in years gone by, as is evidenced by the numerous test pits to be seen in looking over the surface. The recent efforts are deemed more promising than any that have heretofore been made. The ore found is not as yet very clean or high in iron, but it is believed to be Bessemer, and if it shall prove to be so on further investigation, the ore will have a market value that will pay for raising it.

At the time of my last visit, about January 1, they were at work in two shafts; easterly one 86 feet and the westerly one 55 feet deep. They are upon the top of high ground, which slopes away to the south and east. The shafts are about 350 feet apart. At the bottom of the east one they had drifted north into the foot wall 12 feet; hard, slaty jasper, with a percentage of ore. They were drifting south in a lean, hard hematite ore. In the other shaft they had not cross-cutted yet, but were in a lean, hard hematite all the way. One analysis which I have seen of this ore, sampled to give an average, gave 48.9% metallic iron, .008% phosphorus. This low percentage in phosphorus is what gives the main value and interest in the work.

Six hundred feet northwest of the east shaft is an old test pit said to be 100 feet deep, which Capt. Dunn had just begun to pump out with the view to testing the ground in the bottom. There are an engine and boiler and two small hoisting drums used in this exploratory work.

The general business office is in Milwaukee. Officers are W. A. Dunn, F. A. Bates, H. S. Benjamin, N. D. Moore, C. F. Rand. The work is in charge of W. A. Dunn, Agent Iron Mountain, Mich.

THE COMMONWEALTH MINING CO.

owns in fee simple a large estate lying in the Menominee range west of Iron Mountain and in the State of Wisconsin.

The mine has been from the beginning under the superintendence of Capt. W. E. Dickinson and has continued to ship ore each year since it was first opened in 1880.

This work the past year has been in the old pits in the S. W. $\frac{1}{4}$ of Sec. 34, T. 40, R. 18 E.

The underground work done in the past year shows great irregularity in the form of the ore deposit. There is a main run of ore north and south 225' and 25' to 75' feet wide; from this there are three important branches of ore extending to the east and west, those east are 100 feet long, the south one 25 feet, and the middle branch 20' to 75' feet wide. In the northwest part of the underground workings is a pit 50 feet by 70 feet, the bottom is 330 feet below the datum of the mine, to the fifth level. The east of the mine is to the fourth level, 275 feet down. The ore pitches west and at least maintains its magnitude if it does not increase in length. The shafts are designated B & C and are vertical. A new plant of machinery is soon to be obtained; in fact the contract has been let to the Marinette Iron Works Co. to build for the Commonwealth two drums each 10 feet diameter, with such other machinery as will fully equip the mine for getting out a large product.

The company has done a good deal of diamond drill work. Has bored 29 holes of a maximum length of 700 feet, and an average of 400 feet, at an average cost of \$2.35 per foot. The formation is reddish and black slate, the former to the north and the latter to the south of the ore.

The estate comprises 4,000 acres of land in one body.

The ore the past season was sold on a guarantee of 60% iron. It is non-Bessemer. It is picked over carefully, requiring one man to about four cars in loading to sort out the rock.

The mine has produced each year as follows:

Year.	Tons.	Year.	Tons.
1881.....	97,410	1884.....	34,622
1882.....	115,865	1885.....	42,947
1883.....	21,943	1886.....	51,189
Total.....			363,976

W. E. Dickinson, Superintendent Commonwealth, Wisconsin.

THE FLORENCE MINING CO.

The Florence mine shut down in 1883 and has since been idle until a few months ago, when the property was purchased, or a three-quarters interest in the realty by parties in Youngstown, Ohio,—The Briar Hill Coal Co.,—the same gentlemen who own the Iron River, etc., mines; the remaining fourth interest is owned by H. D. Fisher, of Florence, for which he receives six cents per ton royalty for all the ore mined.

The new company began work under the direction of M. J. N. Porter by pumping out No. 4, the new shaft, which was 170 feet below the surface. At the bottom is a cross-cut west, which shows 300 feet of ore, two-thirds of the length of which is clean and first class, averaging 60% in metallic iron and .25% to .30% in phosphorus.

They are sinking No. 4 shaft for another level, when it is believed the ore will improve in quality.

This shaft is 500 feet west from No. 3, with which it is connected underground by a drift.

The portion of the mine to the east of No. 4, Nos. 1, 2 and 3 shafts, has not yet been disturbed, but preparations are making to pump it out, and it is expected that this work will begin before the end of the present winter. A new pumping plant will be secured for this purpose.

From No. 1 shaft, the most easterly one to No. 4 west, it is 1,200 feet. There is continuous opening the entire distance.

I went through the mine in the summer of 1883, a short time before it closed down, and I was impressed with the great amount of ore in sight. In all the shafts are large workable stopes. It seemed to me then that all that was required was a market and the mine could be made to afford a very large product. The operations of the present company in working the mine will be governed by the demand for ore. If the owners can sell it at a profit they will no doubt "push things" to the utmost.

The mine has produced each year as follows:

Year.	Tons.	Year.	Tons.
1880.....	14,143	1883.....	160,155
1881.....	100,501	1886.....	840
Total.....			315,871

Henry Tod, President, Youngstown, O.

J. N. Porter, General Manager, Stambaugh, Mich.

O. C. Davidson, Superintendent, Florence, Wis.

Edward Ball, Mining Captain.

THE IRON RIVER CO.

The Iron River mine is in excellent shape. It has been well handled from the beginning. During the past year considerable activity prevailed. The mine was practically idle during the winter until about the time of the opening of navigation, when it became apparent that the ore could be sold; then the work

began to be pushed, and a product of 78,591 tons of ore were gotten out and shipped.

The work is now confined to the north and south extremities of the section. It will be remembered that the property lies along the section line in sections 35 and 36, T. 43, R. 35, the openings now worked are in section 36, or at the north end, the underground workings may, slightly, at one point cross the line into section 35. All the openings are in the side of the hill sloping to the west to the Iron River, which courses south.

The north mine workings have a length, underground and surface cut, of 1,200 ft. The south part of the north mine is now mainly underground and designated as the Cyr pit.

The bottom is the second level 200 feet vertically down. The first level is 90 feet. The main feature, which distinguishes the manner of the working of the Iron River mine, is the fact that all the underground openings are filled. No timbering is resorted to, but the mine is filled with rock as fast as the ore is extracted. The mine is filled for a length of 400 feet and a depth of 90 feet. The ore body is about 12 feet wide at the ends and 48 feet wide for a length of 200 feet. The rock for filling is mined from the open pit, from the foot wall and hanging of the open cut, and "milled" down into the bottom.

This experience in filling is as favorable as can be desired. It really costs less than timbering; it is perfectly safe and enables them to take out all the ore. The filling becomes nearly as compact as the ledge itself. By the settling and the squeezing of the walls the material is so pressed together that it shows no tendency to slide down when they have come up under it. The main shaft, No. 1, is vertical from the surface down. It is double skip shaft and also the pump shaft. South of it the ore branches, the west branch going towards the river and the other making east into the hill. It is, perhaps, more simply a large "horse of rock" in the lense. About the first of the year they started a new shaft, 600 feet north from No. 1. It will be sunk to the proper depth and they will drive each way in the ore, will timber a drift securely and mill all the ore from the stope, as they rise into it to tram to the shaft.

They carry breast stopes fifteen feet high and fill up, building up to the mills for running down the ore, as they rise and fill in. The present underground working reaches 300 feet north of No. 1. The "mills" are fifty feet apart. "Mills" through the ore will also be made for sending down the filling material. The mills are 4'x4' and made of poles locked together at the corners. Those coming up through the ore serve as pockets in which ore is stored in the summer when there are no cars. When there are cars the ore is drawn out and hoisted.

No. 1 shaft is near the $\frac{1}{2}$ post, 1,320 feet south from the n. w. corner of sec.

36, and for a long way north, nearly to the section line, it is an open cut mine. The first is designated as No. 3 pit, about 32 feet to the bottom, and the ore being of about an equal width. It is in this pit that the new shaft—No. 3—is sinking. The shaft is in the hanging wall and vertical, 8x12 feet inside the timbers. The ore will dump from the shaft skip directly into the pockets above the railroad track. When this shaft is down and “opened up” the underground length of stoping will be 800 feet. In the winter, while the ground is frozen, they are cleaning the ore from the walls of the open cut. Such work can be done in the coldest weather with safety.

After the ore is thus all saved rock from the walls will be used for filling. The walls dip west 80° to 85° . The foot is far better than the hanging. They were, in January last, mining 200 tons per day, working about 140 men, 100 of whom are employed in the north mine and 40 in the Isabella.

The ore is clean, free of rock, 58% to 61% in iron, and averages .48% in phosphorus. The phosphorus is the objection to it.

The Isabella pit at the southwest corner of the section is looking first rate. The ore is now clean, free of rock. Near the surface, when the mine was opened, the ore was capped over with rock and was somewhat mixed; now, however, it is clean. The Isabella as it now stands is a great round cavity 115 ft. deep, 115 ft. long north and south, and an average of 70 feet wide. At the north end a stope 27 feet wide has been worked in 20 feet, and thence on is a drift in ore 76 feet, at the north end of which they are sinking a winze that will ultimately become a shaft; 56 feet south of this winze is a cross drift west 25 feet and in ore. This represents the width of the ore at this point. It has gradually narrowed from being 80 ft. wide at the north end of the open pit until here, 40 feet from the main breast, it has become 25 feet wide. The narrowing is mainly from the foot wall side. This west stope is 50 feet high and 50 feet wide at the south end and 25 feet at 40 feet further north.

The bottom of the pit is ore. South from the open pit the ore makes off in two branches. The new shaft will be in the foot wall. It will go down below the bottom of the open pit and they will drift from the shaft below the present workings.

The ore will be hoisted on the east side of the mine and will be run over to the west to the ore dock. A new plant of machinery is to be erected. That at present in use at this mine is entirely inadequate to handling a heavy product.

There will be a new engine house on the foot wall side, with three five foot drums, new engines and two new boilers 16'x60".

The ore is about of the same quality as that at the north end. An average of a great many analyses gives

Metallic Iron.....	61%
Phosphorus.....	.48%
Silica.....	3.50%
Lime.....	.46%

The pit produced 31,000 tons the past season and will probably easily afford 50,000 in '87.

The Co. has a laboratory and employs a chemist at the mine and the ore is constantly sampled and analyzed.

The annual product of the Iron River mine has been as follows:

Year.	Tons.	Year.	Tons.
1882.....	29,115	1885.....	55,693
1883.....	100,369	1886.....	78,591
1884.....	52,584		
Total.....			316,352

Robt. McCurdy, Treasurer, Youngstown, Ohio.

James N. Porter, Superintendent, Stambaugh, Mich.

THE SELDEN MINE

is a small pit opened and worked to a limited extent, near the water tank, on the east of the railroad track at Stambaugh, 200 feet north of the south line of the property and 350 west of the east line, being the N. E. $\frac{1}{4}$ S. E. $\frac{1}{4}$ S. 35, T. 43, R. 35.

The ore was uncovered by the railroad company in building its track and the option was held by the Iron River Co., who relinquished it last year, when it was taken by Messrs. Polderman and the St. Clair Brothers. The Iron River Co. expended on this property in option fees and in exploring work \$1,500. The owner's terms were excessive, requiring the company to pay 50 cents a ton royalty, and to mine 5,000 tons a year or pay royalty on that amount. As the ore is poor quality, high in phosphorus and low in iron, there was no sale for it, and the Iron River Co., tired of paying \$2,500 a year, threw up the lease.

The present holders are preparing to organize a company and provide the machinery for working the mine the ensuing year.

The shipments in 1886 amounted to 790 tons of ore.

Geo. A. St. Clair, Superintendent, Ishpeming, Mich.

THE BETA MINING CO.

This property lies adjoining the Nanaimo—east of it—being the N. E. $\frac{1}{4}$, S. W. $\frac{1}{4}$, S. 26, T. 43, R. 35. They have simply mined out a small pit about 50 feet across and 50 feet deep from which 2,000 tons of ore have been taken out and shipped.

Capt. Thomas Luxmore, who is directing the work, states that he has traced the ore for a length of 600 feet.

The ore was mined and sold by John McDonald, of Iron River, who held a lease of the property.

The mine will be operated by the company during the year 1887. There is a small plant of machinery on the ground.

The officers are: H. O. Fairchild, President, Marinette, Wis.; D. C. McKinnon, Secretary and Treasurer, Iron River, Mich.

THE NANAIMO MINING CO.

is now engaged in operating its mine. A year ago it was idle and there was no product to report.

They are working in the old pit. The south one is the one nearest the river. This is the pit from which the first ore was taken. The work is all underground, mainly in the second level, 180 feet below the surface. A shaft goes down at the east end, dipping 65° westerly. The first level had a length of ore of 200 feet of a variable width, but attaining to 90 feet maximum and averaging about 40 feet. The second level has not been fully opened but affords every evidence of being equally as good as the first. They are also mining out the pillars left in the first level, letting the top all in and making it an open pit, hoisting from it with bucket and derrick.

The north pit is full of water. The mine is pretty well equipped with machinery—three hoisting drums—each 4 feet diam.; 4 boilers, $16' \times 4'$.

A trestle connects the mine, with the furnace built on opposite side of the river, 1,200 feet away. But the anticipation that this furnace would use all the ore of the mine failed to be realized. They did not for some time succeed in making the ore work well in the furnace alone; they found it necessary to mix it.

The unfortunate destruction of the furnace by fire in August last put an end to the consumption of the Nanaimo ore from this source and rendered the long trestle useless.

The ore is of about the same quality as that of the Iron River mine—possibly a little lower in phosphorus.

The company employs now 60 men. There are 5,000 tons of ore in stock and perhaps 10,000 tons in sight in the stopes.

The officers are: J. C. Wedge, President; John Spence, Secretary and Treasurer, Fond du Lac, Wis.; Wm. Bond, Mining Captain, Iron River, Mich.

The product of the mine for each year has been as follows:

Year.	Tons.	Year.	Tons.
1882.....	2,250	1884.....	38,766
1883.....	29,221	1886.....	5,400
Total.....			74,721

THE YOUNGSTOWN MINING CO.

has recently resumed work. The mine is at Crystal Falls, in Sections 19 and 20—N. E. $\frac{1}{4}$, S. E. $\frac{1}{4}$ of Sec. 19 and N. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$ of Sec. 20, T. 43, R. 32. The mine is in what was originally a cedar swamp at the foot of a hill which rises up steeply on the south. The mine was first worked in section 19, and the engine house was built near the west line of the property. Further exploration to the east developed the fact that the ore in larger body existed near the line between the sections than had been found to the west. The testing that was done led to the inference that the ore existed in two veins, parallel with each other, running east and west, and the plan was devised of sinking a shaft in the rock between them, intending to work the ore in the deposits each way from the shaft. The shaft is designated as No. 4. It is a short distance east of the line in section 20, and is 120 feet below datum at the bottom. No. 5 shaft is 160 feet east from No. 4 and is but 63 feet deep. The two are connected by drift below the surface. The deposit is 200 feet wide all clean ore, and even yet no well defined walls are found, though the extreme limits on the north and south are mixed, rock and ore.

They have worked east from the shaft 100 feet and west 125 feet. The openings are in ore—east of No. 4. The ore is high in manganese.

The following analysis indicates the quality of the ore from the shaft:

Metallic Iron.....	54.5 %
Phosphorus.....	.57 %
Silica.....	3.00 %
Manganese.....	4.50 %
Lime.....	2.50 %
Aluminum.....	1.30 %
Water.....	6.00 %

The ore is compact and hard, and stands well in the mine, so that it can be

mined out, leaving large chambers. In this respect it is like the Norway. The roof does not show a disposition to fall out. They are opening the mine in such a way as to afford a number of stopes, which will enable the company to make a large output the coming year. If the ore can be sold at a profit there will be no difficulty in securing the supply.

A new plant for operating No. 4. shaft has been contracted for, which includes hoisting machinery, compressor and air drills. The latter are needed in this hard ground; with them the ore can be mined far more cheaply and rapidly. A fine ore dock extends the whole length of the mine, and the railroad track has the inclination requisite to allow the cars to run down along the dock—away when loaded and to come down as required. The ore must be elevated to a considerable height to be above to the stock pile.

Work was begun, after an idleness since 1887, on the 1st of May last, making the first shipment on the 2d of June. The average working force since July has been 90 men. They mined and shipped 25,000 tons and intend to have in stock by the opening of navigation in the spring 20,000 tons. The product for 1887 will be about 50,000 tons. It may exceed that amount if the ore can be sold.

The average of the analyses of the ore shipped in July gives in iron 56%.

“ “ “ “ “ “ “ “ “ “ August “ “ “ 57%.

“ “ “ “ “ “ “ “ “ “ Sept'r “ “ “ 57%.

The average in phosphorus was .41%.

The officers are: J. N. Porter, general manager, Stambaugh, Mich.; E. J. Gilbert, superintendent, Crystal Falls, Mich.; Thomas Ball, mining captain, Crystal Falls, Mich.

The mine has yielded as follows:

Year.	Tons.	Year.	Tons.
1882.....	6,198	1884.....	8,343
1883.....	15,292	1886.....	25,638
Total.....			55,469

THE PAINT RIVER MINING CO.

is also actively engaged in mining work, after a period of idleness into which, in common with many other mining companies, it was forced to remain; it is now preparing for a season of prosperity. The new “find” described in my last report is turning out well—all that was anticipated—and will afford the Paint River Co. a large output.

This new deposit was struck at a point 400 feet north and 600 feet west of the main shaft in the old mine. It is near the west line of the property and extends into lot 6, section 20, which latter property has been also secured by a lease to members of the Paint River Co. and will be worked by the company as a separate concern. This ore seems to be the easterly continuation of that at the Youngstown mine which is on the same section on the opposite side of the Paint River.

In the new mine are two shafts 200 feet apart. The west one is 84 feet east from the west line and 100 feet deep, and they are sinking for another lift December 20th. The ore body is 75 feet wide and they have bored in the bottom 200 feet down, all in ore. Borings have also been made on the north and south sides of the shaft to test the width of the ore, so that they have it sufficiently proved to assure a good mine at least for present purposes. The plan is to fill the mine and not use timber. The ore does not vary much from that of the Youngstown; runs 58% to 70% in iron and .20% to .70% in phosphorus, low in silica and has a percentage of lime. It has a low density. It is expected to mine 30,000 or 40,000 tons the coming year. Capt. C. T. Roberts, who has had charge of the mine since it was first opened, in 1881, has the mine now, on lease; that is, he mines the ore for a certain price per ton—90 cents—paying all the costs himself, the company making the improvements, etc. Capt. Roberts, who has heretofore resided at the mine, has moved to Mastadon, and Mr. C. T. F. Scaddon will act as superintendent. Frank Rahe and others have a sub-contract for mining the ore. Between the Paint River and the Youngstown are the falls in the river which could be cheaply utilized for operating mining machinery as at the Chapin, etc. No work is doing in the old mine.

The Paint River mine has produced annually as follows:

Year.	Tons.	Year.	Tons.
1882.....	4,615	1885.....	2,374
1883.....	5,971	1886.....	13,933
1884.....	11,546		
Total.....			48,439

M. R. Hunt, General Manager, Chicago, Ill.

THE FAIRBANKS MINE,

which joins the Paint River on the east, has been wholly idle for some years.

The mine produced in 1882 8,131 tons of ore. Joining the Fairbanks on the east is the Great Western mine, the property of

THE IRON STAR CO.

One year ago when I visited the mine it was idle and full of water. Captain Hooper was then engaged exploring with the diamond drill and reported excellent results. Subsequently the mine was "pumped out" and matters put into shape for the active prosecution of mining work, and the result has been that 25,725 tons of ore have been mined and shipped during the past year.

They have hoisted from two shafts, Nos. 1 and 3, and have sunk the former an additional "lift" of 92 feet to the 4th level, which has not been very largely opened yet. It will be available for the coming year's work. No. 1 is the westerly shaft, 170 feet east from the west line of the property, and No. 3 is about 220 feet east of the former and is down to the 3d level; they hoist in it with bucket. No. 1 is a cage lift to the 3d level. In the 3d level the mine has a total length, underground, of 510 feet, commencing at about 100 feet west of No. 1 and extending east. The ore is found in several lenses or pockets, succeeding one another east and west and separated by "bars of ground."

No. 1 was formerly an open pit, but has been filled and the shaft left open through the filling; the last level—the 4th—the shaft was sunk in rock, and they have cross-cutted to the ore. The ore looks well in all the stopes, though it is by no means everywhere alike in the mine. They have a fine blue ore that is of most excellent quality. Much pains is taken in keeping the ore clean and free from rock, and this care, with the good qualities of the ore itself, has given it a good reputation among furnace men recently and created a demand for it. The following analyses of 12 samples of the Iron Star ore were made by Mr. C. E. Wright, of Marquette, and illustrate its qualities. They were taken and made at different periods.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.	No. 9.	No. 10.	No. 11.	No. 12.
Iron	64.02	62.86	62.93	62.92	63.08	61.85	64.31	64.57	65.96	63.21	64.62	64.20
Phosphorus.....	.076	.058	.102	-----	.102	.130	-----	.076	-----	.087	.107	.079
Silica.....	1.62	1.29	2.82	-----	3.118	-----	-----	-----	-----	3.67	2.55	2.85
Aluminum.....	-----	2.67	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Lime.....	-----	-----	-----	1.08	-----	-----	1.10	-----	-----	-----	-----	-----

The mine is timbered after the Nevada system and is in fair shape. The most unpleasant feature connected with the mine is the over abundance of water. It is an exceedingly wet mine. I hardly see why the upper levels and stopes should be so wet; but everywhere, in all parts of the mine, the water is

dripping from the "back." Generally, in mines, the water finds its way to the bottom, leaving the upper levels dry, but in the Iron Star the first level is as wet as the fourth, at least, it is as disagreeable in this respect to examine. To raise the water the force of a No. 10 short stroke Cameron at No. 1 shaft and a No. 11 long stroke Cameron at No. 3 are brought into requisition. It is the plan to run the water to No. 3. A launder 700 feet long conducts the water from the shafts in the direction of the river. The total force employed is about 100 men. It has always been understood that the Iron Star ore was of better quality than that of most mines in the Crystal Falls district when properly selected; and the care which the present company exercises, in this particular, leaves nothing to be desired.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1882.....	587	1884.....	20,722
1883.....	22,825	1886.....	25,725
Total.....			69,859

The location is about a mile in direct line from the village of Crystal Falls, in section 21, T. 43, R. 32.

V. K. Moore, Sec., Detroit, Mich.; Wm. Hooper, Supt., Crystal Falls, Mich.

THE BERTIE

is an exploration that is now making by Capt. W. A. Dunn, east of the Iron Star. The work was but recently begun and ore has been already struck.

THE KIMBALL IRON CO.

is a recent organization with Mr. Henry R. King President; Secretary and Treasurer, J. P. Whaling, Milwaukee, Wis. The estate is the E. $\frac{1}{2}$, S. E. $\frac{1}{4}$, Sec. 29, T. 43, R. 32, close to the village of Crystal Falls, near the saw-mill, and near the Sheldon and Shafer railroad branch. The exploration was formerly known as the Juniette, work having been done here by Mr. S. D. Hollister in 1882. It appears now that the earlier work was done too far north in the north "forty" in a banded ore formation. Recently Dr. H. C. Kimball, of Crystal Falls, secured an option and has now thoroughly tested the location with excellent results. He has sunk six test pits in the south "forty," north of the slope, which forms the foot wall of the ore. The formation runs

east and west and dips north. A particular description of the pits will indicate what is the prospect for a mine, and how much has been done to prove it.

No. 1 pit is 67 feet deep, 44 feet of which is in the rock. At the bottom is a drift south 17 feet to the foot wall and one north 9 feet. Pit No. 2 is 45 feet deep, is in the hanging wall, 3 feet north of the ore. Nos. 3, 4 and 5 pits are in ore and No. 6 is in the foot wall. No. 1 pit is 126 paces from the south line and 240 paces from the east line. The pits are 80 feet apart east and west except No. 2, which is 46 feet north of No. 1.

In No. 1 they have cross-cutted in the ore and have ore 40 feet, and have thus proved by the pits a length of 400 feet. It is a fair quality of ore, showing, by the samples that they have had analyzed, a percentage in iron of about 60% and of phosphorus of about 12%. Some analyses gave a lower percentage in phosphorus. The land is owned by the St. Mary Ship Canal and Land Co., by whom it is leased to Laurus Silverman, of Chicago, and in turn by the latter to Dr. Kimball, and he again has transferred his right to the Kimball Iron Co.

No doubt a mine will be opened and operated the coming year.

THE DUNN MINING CO.

has the most promising exploration in the vicinity of Crystal Falls; it is in Section 1, T. 43, R. 33.

There has been a great deal of exploring work done on this section in years past. The parties who now hold the property have "shown up" enough of ore to insure a mine. The formation runs north and south and dips west. Along the slope of the hill, which inclines to the east, the company has stripped the ore for a length of 40 feet. It was covered by nearly 20 feet of sand and gravel.

They have sunk near the north end and drifted east so that they have shown thus a width of ore 60 feet. The ore is similar to the Mastodon, about 60% in iron and somewhat high in phosphorus. The work done is 80 rods north from the south line of the property. A little way south of this south line considerable exploration has been done but nothing of value found. A track will be made by extending the Mastodon branch north to this location two miles.

The land is owned by Geo. Sheldon and Luke Welch and is held on a lease by Messrs. J. H. King, W. A. Dunn *et al.*, Cherry Valley Iron Works, Ohio, who have organized the above named company.

THE BLANY IRON CO.,

S. $\frac{1}{2}$, S. W. $\frac{1}{4}$, Sec. 27, T. 43, R. 32, about one and a half miles from Crystal Falls. The land is owned by the Canal Company. There has been a great deal

of exploring work done on this property with not very satisfactory results. Much money has been spent, and it by no means appears that there is ore enough anywhere to pay for mining. The land is level and deeply covered with drift, through which numerous pits have been sunk. One pit is 90 feet deep and they have drifted in its bottom 90 feet, with a lesser length south, in more or less mixed ore. They have nowhere found a considerable width of clean ore. Near the south side of the property they were sinking a shaft at the time of my visit, which was about 90 feet down. The plan was to continue 20 feet further and then drift north and south 100 feet. At the bottom about half of the shaft was in ore, the rest rock. The ore is of good quality; samples analyzed have proved to be Bessemer, and the fact serves to sustain the expensive effort which is making to find a body of it.

The indications are good—ore is found in many of the pits, but in no large quantity. The work now doing is altogether south from the earlier explorations. The line of pits is north and south, but where they are at work it seems that the formation tends east and west. Captain John Morrison, an experienced mining man, has charge of the work.

On Section 22, T. 43, R. 32, Mr. H. D. Fisher is conducting an exploration that promises well.

THE SHELDON AND SHAFER MINE

has been worked during the past year. Mr. Sheldon was getting ready to pump out the pit at the time I visited the mine in October, 1886. The work has been confined to the old pit, which then was about 200 feet long east and west, 80 feet deep and 30 feet wide on top, narrowing to about 12 feet at bottom.

The cut has not been deepened, but has been worked out at the east end, north and south, so that here the pit is much enlarged; a drift at the bottom has been made 100 feet east and one also of an equal length north; 400 feet east on the south side of the railroad track they were sinking a test pit when I last visited the mine, December. This test pit was bottomed in ore and looked favorable, but the ground is wet and they were making slow progress on account of the water. The ore is of pretty good quality if it could be got free from rock with which it is mixed.

It not unfrequently happens that this mixed character of the ore deposit is confined to the part near the surface, and when greater depth is attained the ore becomes uniform and free of rock. I think it would be an excellent plan at this mine to sink deeper; go down to at least twice the present depth and then cross-cut the formation.

The new engine-house has been built and suitable machinery provided. A

double skip road is built down on the south wall of the pit. The land is owned by the estate of R. Sheldon and J. F. Shafer, and the mine is operated by the owners, C. D. Sheldon acting as agent. There are 320 acres, a fine body of land, being the N. W. $\frac{1}{4}$, S. 31, and S. W. $\frac{1}{4}$, S. 30, T. 43, R. 32.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1882.....	15,947	1884.....	6,774
1883.....	4,334	1886.....	14,282
Total			41,337

THE CALEDONIA IRON MINING CO.

This exploration was fully explained in my previous report, and there is but little to add. The location is in Sections 17 and 20, T. 43, R. 31 W., on the west bank of the Michigamme river, near which the work has been done.

The dip is west at a steep angle. The company sunk, about three years ago, two shafts—one of them in the line between sections 20 and 17, 83 feet deep, 65 feet of which was in the ledge, mixed ore and rock. At the bottom they cross-cutted 25 feet in ore. A second shaft was sunk north and west respectively from the former 200 and 100 feet. It is 90 feet deep, 8' by 16' in size. They drifted from the bottom 13 feet east in rock and then intercepted clean ore, in which it is stated that they continued for 30 feet without finding the wall. Nothing further was done until last summer when parties from Negaunee sought to pump out the shaft to examine it with the view to purchase, but, being provided with inadequate machinery, failed to accomplish it. The 1st of November, however, Messrs. Moore, Benjamin & Co., of Milwaukee, having taken an option on the property, engaged Captain C. T. Roberts, of Paint River mine, to free the shaft of water. This Captain Roberts succeeded in doing in short time. He suspended a pump in the shaft with a wire rope, and then using rubber steam hose, he pumped the water all out in nine hours after the pump started. He completed the drift for a length of 15 feet, and the analysis showed the ore to be within the Bessemer limits—63 % in iron and .008 % in phosphorus.

It is this fact of the percentage of phosphorus which gives interest to the property. The extension of the Milwaukee and Northern railroad west goes near the property and when this road is built no doubt the mine will be worked. It is eight miles from Crystal Falls, to which place there is a good wagon road. Messrs. Moore & Benjamin are still further exploring the property. The work is done under the supervision of C. T. Roberts.

Since writing the above it is announced that Messrs. M. B. & Co have relinquished the lease and ceased work.

MASTODON MINING CO.

From Crystal Falls to the Mastodon mine is one of the best hardwood sections of country to be seen anywhere. It does not end at either of these termini, but continues uninterruptedly, fine hardwood forest. It is a pleasure to ride through it in summer or winter.

When I visited the Mastodon mine, in October, 1886, it was full of water—nothing was doing except with the diamond drill. They are boring at the north end of the mine—had made two holes, one to the east at an angle to the horizon of 60°, 276 feet deep; the other, which was then boring, was from the same station, but was turned to the west at an angle of 65°. Both of these holes missed the ore—it lay between them, and the fact of its existence was made manifest when the third hole, a vertical one, was bored, stopping in ore after going through 200 feet of it. The pit was soon after pumped out, and the work of stoping and hoisting ore begun. Captain Roberts stated that under the water the bottom was all ore—100x180 feet, and he did not exaggerate, for they have mined out and sold from this pit the first season 41,640 tons and there is all of that amount in sight in the mine. The long way of the ore is north and south. The whole product is hoisted in one skip. The skip load descends to the west into the open pit and then flattens and goes still further west into the open chamber, where they are now stoping. The ore is capped with a thick deposit of sandstone, horizontally bedded; it is clean—entirely free from rock, hard and compact. I know of no hematite that stands better. There is practically no water to contend with.

At 220 feet north from No. 1 skip road they are sinking a vertical shaft, which is now, December, 80 feet deep, following the drill hole. Here they bored in 200 feet of ore and are thus sure of soon opening up a fine pit. A new plant of machinery has been secured and will be placed to operate this shaft.

Captain C. T. Roberts has taken the contract for two years, to mine the ore at 90 cents per ton. The company provides the machinery, sinks the shaft, and also builds some necessary houses, etc. He estimates that he can furnish the coming year, 100,000 tons, and I see no reason to doubt it. The company does not agree to take that amount, but will accept all it can sell. The minimum amount fixed on is 40,000 tons. Analysis of the drill core gave 64% in iron, .119% in phosphorus, 2.20% silica.

Hon. Edward Breitung, president; Joseph Austrian, general manager, Chicago, Ill.; C. T. Roberts, agent, Mastodon, Mich.

The mine has produced as follows:—

Year.	Tons.	Year.	Tons.
1882.....	3,477	1885.....	11,773
1883.....	18,577	1886.....	41,640
1884.....	18,020		
Total.....			93,451

The estate is the S. $\frac{1}{2}$ N. E. $\frac{1}{4}$ S 13, T. 42, R. 33 W.

THE DELPHIC IRON CO.

At the close of the year the Delphic mine was not promising in appearance. The ore was exhausted, or nearly so, and they had not at that time succeeded in finding anything that afforded much encouragement for the future.

Since my visit to the locality, I understand, better results have been met with and that further efforts in the exploring work are now in a fair way to be rewarded with success. The mine is in Sec. 24, N. E. $\frac{1}{4}$ S. W. $\frac{1}{4}$, T. 42, R. 33. The control was held by the late Samuel J. Tilden, of New York, and this interest was devised to W. W. Whittlesey, who is one of the distinguished gentleman's legatees.

It is operated by W. W. Whittlesey Bros. & Co., Florence, Wis., lessees of the Delphic Iron Co. The mine has produced:

Year.	Tons.	Year.	Tons.
1883.....	3,410	1885.....	9,843
1884.....	508	1886.....	17,684
Total.....			31,445

The ore is of a good quality of non-Bessemer hard hematite. The plan is to use a diamond drill.

The other explorations in the Mastodon range have been described in previous reports, and at none others than those herein mentioned has any work been done in the past year.

THE MARQUETTE IRON RANGE MINES.

The oldest, and among the best, iron mines in the State are found in the Marquette district. It was the mines of this range that established the reputation of Lake Superior ores. They are the pioneers and began the struggle in

that early day when Lake Superior was practically far remote from civilization and the markets of the world.

They were wonderful mines, those earliest worked. Deprived of the seeming advantages of location possessed by other iron mining districts of the country, but solely through the surpassing value of the ores, the great extent of the deposits, the intelligence, enterprise and perseverance of those who devoted themselves to their development they established for this region a reputation that secured its ultimate success and prosperity and placed it in the foreground with the chief mining districts of the nation.

It is no wonder that the early residents of Lake Superior—"the old timers"—hold in especial regard these old mines, so identified with their early struggles in the country, the ones on which they so greatly depended for ultimate success, and through which that success was finally achieved. There is sentiment in these matters everywhere, and in Lake Superior, owing to the extreme isolation of the country for a long period, these local attachments had peculiar opportunity for development. The new generation can scarcely appreciate the feeling with which the early resident of the copper region regards the old Minnesota and the Cliff—the enthusiasm with which he will recall those early days in copper mining, and in the Marquette region, as well, there are mines which the old mining men are ever ready to praise and of which anything favorable gives to them unusual satisfaction.

And well may these old mines be regarded with favor. They were the first to establish the reputation of the ores of the region, and have ever maintained it. The old mines are still leaders in quality and in quantity of production. The Marquette range is still the largest producer of ore. It is the only producer of hard ores, magnetic and specular ores.

Though the oldest of the mining districts, there is nothing obsolete about it. It is a region of wonderful enterprise and progress. Old fogyism in mining work finds no resting place among the old mines of the Marquette range. Nowhere in the world is this industry more nearly abreast with the times than here. Visit one of the old mines, the Cleveland, Lake Superior, etc., and see what magnitude and perfection of equipment. The buildings and shaft houses are of the most substantial kind—the important ones of stone and iron. The machinery is all of the most powerful and latest construction.

One is impressed with the fact that he is examining a mine; a mine in the largest sense of the term. If he goes down into the mine he may descend hundreds of feet into the earth and traverse long drifts, view the gloom of immense chambers and caverns from which has been extracted the ore that for thirty years has unceasingly flowed through these drifts and shafts. He beholds stopes of ore that suffice to assure him that there will be no diminution in the

supply of mineral which the mine has been accustomed to afford. The valuable record established by so many years of intelligent management, of unfailing richness of ore and uniform greatness of production, is precisely the record that there is the best evidence will continue to be maintained in the future.

There are many mining locations in other more newly developed localities where a large product of ore is obtained and where one sees little of the outlay and preparation for mining observed at the older mines. Some of them are mere cavities, open to the surface, where the ore is mined in the simplest possible way, only such machinery being used as is essential to operate derrick and bucket or simple skip way. In after years it is probable that the newer mining sections will assume the appearance which the older one now has.

They will profit by the experience of the pioneer mines; they have already done so. The old mines have been schools for educating miners. The most of the mine managers, mining superintendents and captains of the new mines are men who were formerly employés of the old companies. Men who got their knowledge of the work in the old mines. The new mines start with the experience of all the previous years and have available at the outset the latest improvements and methods.

There is nothing new or valuable in iron mining that will not be found in use in the leading mines in the Marquette districts, and nowhere will one find a more progressive spirit or more intelligent management. In describing the mines of the Marquette range I shall, as is usual, speak of the older ones in their chronological order, and thus begin with

THE JACKSON IRON CO.,

a namesake of the important city of that name in southern Michigan. The original company was formed in that city by men residing there who first obtained title to the property and did some incipient mining work. The first ore taken from the mine was taken to Jackson and there worked into iron at a country forge, the first iron ever made from Lake Superior ore. It was also, prior to this, that in running the west line of the Jackson mine the U. S. surveyors made the discovery of the existence of iron ore in place in this country. All this early history has been fully gone over in previous reports and will not be reiterated here; the subject has been exhausted and there is nothing to add.

In 1872, when the gentlemen who were engaged in this early enterprise were still living, as were also most of the members of the government surveying party that ran out the lands referred to, I gathered from them by personal interview and by letters all the evidence bearing upon the subject and thus wrote out the history in brief for the State geological survey of the iron region. I only mention these facts because I am sometimes asked for information regarding the

early history of the iron mines, and also that I occasionally meet with statements in the papers which are at variance with the facts. A brief historical sketch of the discoveries and early development in the iron regions is embraced in the State Geological Report of 1873, and also in the first report of the Commissioner of Mineral Statistics, 1877-78.

In my last report, written a year ago, I gave a long description of the Jackson mine. I spent several days at the mine, going through all parts of it with Capt. Merry, and wrote it up, as I termed, fully. I shall, therefore, confine myself mainly to what has transpired in the last year. The open cut and underground workings of the Jackson mine extend almost continuously the whole distance east and west through the south half of Section 1, T. 47, R. 27, and upwards of half a mile north and south. Almost the entire area of the S. E. $\frac{1}{4}$ is filled with these mine openings. Great rocky chasms artificially formed, and vast caverns, far beneath the surface, where the ore has been extracted in years gone by; innumerable drifts cut through the rock, winding in every seeming direction, connect these underground chambers, forming a labyrinth so extensive and intricate that only such a thread as the experience of Capt. Merry constitutes, will serve to guide you through in safety.

Many of these old openings still afford places where ore is mined. A man can start in almost anywhere and find ore. There is a great deal of this "scramming" done at the Jackson. Quite a proportion of the annual product comes in this way. Not unfrequently one of these "scrams" leads to the finding of a large deposit of ore. Some of the best pits that have been had in recent years were discovered in this way, as the No. 7, No. 8, the Merry pit, etc., and even now, at the present writing, they are developing such a "find" that was recently made, and which is promising finely. The discovery was made in old No. 1 pit, where a miner had a contract for scrambling all the ore he could get in the sides of the pit. He worked a little in the bottom and found what he knew to be a body of larger size. Carefully concealing his discovery, he went to Capt. Merry and wanted his contract enlarged so as to include the entire pit, the bottom as well as the sides. The Captain has become so accustomed to this sort of thing that he surmised as soon as he saw the man that he had found some ore, but he declined to enlarge the contract. The company is now working in this ore in the bottom of No. 1 pit, and is also driving towards it in No. 9 pit, which is to the northwest. This stope in No. 9 is the best thing in the mine, in sight, at the present time. They are 162 feet below the tunnel level, and the ore is of the best quality, of fine, hard ore, 14 feet to 25 feet wide. No. 6 pit, which for many years has afforded the best hard ore stopes, is becoming exhausted.

No. 7 and No. 8 pits, and the South Jackson, are all looking exceedingly

well. The former has not been sunk any deeper during the last year. When I went into the pit a year ago, the bottom level had but recently been reached. It was not then promising well. So far as opened, it was mostly rock. Drifts below the ore body, where a continuance of the ore was expected, showed the ground to be rock. Further development, however, proved that the ore body, though somewhat changed in position, had not diminished in magnitude, and several of the largest stopes were worked in this pit. Ore is now to be seen in the bottom of No. 7. The pit produced last season 15,000 tons, and will do equally as well the coming year. Its depth to bottom is 207 feet.

No. 8 is also looking even better than it did a year ago, and at that time I stated that it was the best pit in the mine. The skip level down the north side is 200 feet east of No. 7 shaft, and is 100 feet deep, one level below the bottom of the open pit. No. 8 is becoming a hard ore pit, and the ore is of the best. The product of this pit last year was also 15,000 tons, and it is sure to duplicate the amount in 1887.

South Jackson has not looked so well at this season for several years as it does now, and the ore has become, Capt. Merry states, of better quality than formerly. However, the ore in the east end of the mine was always higher in phosphorus than that found in the west part, and it is here that they are working, and where the ore has been mined that went into last year's product, 18,330 tons. They are now sinking for a new level for the coming year's product.

About midway to this mine east and west is a tunnel, which goes in south. Through this tunnel is laid the railroad track over which the ore goes from the mine. The new workings just mentioned are west of this tunnel. East of it, near the east line of the section, they have a run of ore 250 feet long, 10 feet and upwards in width. The South Jackson is in the southeast corner of section 1, and behind it, in section 12, five or six hundred feet, rises the greenstone cliff to which the workings in both mines extend—that is, they have worked up to the greenstone both in the South Jackson and in Section 12 mine, particularly in the latter, which is, however, one of the Iron Cliff Company's mines.

The Merry pit, so fully described last year, shows some improvement from what appeared then. A drift in the hanging near the top opened into a body of ore that is of some value.

Altogether the Jackson mine will easily afford as large a product the ensuing year as the last. If required it could be much increased.

The company employs an average force of 200 men.

The most surprising thing connected with the Jackson Co. is the recent sale of the controlling interest in the stock. A change in the management of this old corporation is a genuine sensation. The purchasing parties are Capt. Sam.

Mitchell, of Negaunee and the Cleveland Rolling Mill Co. It illustrates the opportunities which our country affords for bettering one's circumstances, that Capt. Mitchell, who came to Michigan from England not many years ago a poor miner, and by his honest industry and intelligence should acquire such a fortune as to enable him to become a chief owner of the great Jackson mine. The original company was formed in 1845. Subsequently, in 1848, an act was passed by the Legislature incorporating the company under the title of the Jackson Mining Co. of Mich. In the following year the charter was amended by which the name was changed to the Jackson Iron Co. I understand that no changes have since been made. The company has been a very conservative one and its affairs have been well managed. It has probably made more money, returned more to the stockholders, than any other mining company in the State except the Calumet and Hecla.

The stock is divided into 12,000 shares and in the recent transfer the price per share was fixed at \$125.

In the estate is included the lands and furnaces at Fayette on Lake Michigan. Capt. Merry informed me that he should withdraw as soon as the transfer was completed. He has other matters to which he wishes to give his time.

Two fatal accidents have occurred in the mine the past year.

The officers are Henry Merry, Supt. etc., Negaunee, Mich. Fayette Brown, Gen'l Manager, Cleveland, Ohio.

The Jackson mine has produced annually as follows:

Year.	Tons.	Year.	Tons.
Previous to 1856 (estimate).....	25,000	1871.....	132,297
1856.....	417	1872.....	114,910
1857.....	12,442	1873.....	130,131
1858.....	10,309	1874.....	94,708
1859.....	28,377	1875.....	87,288
1860.....	41,295	1876.....	98,480
1861.....	12,919	1877.....	80,340
1862.....	46,046	1878.....	83,120
1863.....	77,237	1879.....	112,921
1864.....	83,905	1880.....	120,622
1865.....	65,505	1881.....	118,939
1866.....	92,287	1882.....	93,670
1867.....	127,491	1883.....	71,278
1868.....	130,524	1884.....	76,626
1869.....	125,908	1885.....	67,657
1870.....	127,642	1886.....	89,525
Total.....			2,584,892

THE CLEVELAND MINING CO.

No mine in the country gives one a stronger impression of a great mine than does the Cleveland. Its fine stone buildings for hoisting machinery, machine shop and pump house, so elegant, large and commodious; its magnificent machinery, of the latest and most powerful pattern; its great shaft buildings, imposing and strong; the fine, smooth location, ample in size, convenient and attractive; the air of neatness, order and good management which everywhere prevail, quickly inspire the beholder with admiration and confidence. There is nothing ruinous or antiquated to be seen; all is fresh, substantial and to the purpose. The outlay is for the maximum work of a great mine and impresses one accordingly. The Cleveland is a large mine. It covers a good deal of space above ground and far more than the usual area underground. Measured horizontally there is no mine in the district that has so great an extent of opening. It is a long, flat mine, much of it, that spreads a great way east and west and north and south. The Incline pit from the extreme west end to the top of the skip road where the ore reaches the surface is 1,240 feet, and 320 feet wide in widest places. The ore has narrowed at west end so that the extreme west stope is not more than 50 feet wide. The pit has not increased in depth very much, being only 300 feet below datum at lowest point. The Incline has been worked for many years, and has been, always, the chief pit of the Cleveland Co. A few years ago the ore was clean, 80 feet high and the full width of the pit. But now the ore is mixed with jasper, that is, it is banded, a few feet of ore and then rock; the stopes of ore being not more than four feet wide of clean ore. The stope is about 30 feet high. The ore has to be picked over carefully, as considerable rock gets mingled with it when it is broken in the stopes, so that in order to make it first class it has to be looked to carefully.

The ore for years has been trammed from the stopes to a big pocket in the mine, which is 450 feet west of the shaft horizontally. 440 feet from this point west is a skip road over which the cars are hauled up to the level of the pocket. The inclination of this skip road is 12° with the horizon. From the top of the skip way the ore is trammed to the pocket.

South from the east part of the Incline pit they have a scam of good ore which furnished a small product. This ore is 70% in iron, and $.023\frac{1}{2}\%$ in phosphorus.

No. 3 pit, which also extends east and west, lies north of the Incline, and along the north line of the property. It is limited by the New York mine on the north. The skip level in No. 3 is a quarter of a mile long, it is also deeper than the Incline, being 550 feet deep at west end.

The pit is larger than the Incline, the skip way starting from the surface at the west end goes down 300 feet to the point where it goes under ground;

then for a distance of 550 feet it lays pretty flat, following the lay of the ore, varying in its inclination from 11° to 21° with the horizon. At this point the skip road turns down at an angle of 57° , and at the same time bends horizontally 25° , following the ore. The fold in which the ore lays inclines to the south and west, so that it is possible that it may come into the Incline on the upturn of the fold. But I hardly think that. I think rather that it is a separate underlying fold. The ores are wholly different; still both have quartzite hanging and soap-rock foot-wall. The west end pitches down more sharply to the southwest. The width of the workings north and south is 300 feet. There are 6 or 7 levels, and the greater portion of the ore is left in the mine in pillars, etc. At least two-thirds of it is yet standing in the levels that have been passed. They take out a stope 20 feet high, leaving 40 feet of back in each level. In the bottom working level the ore is about 80 feet wide. It is not first class. They designate it as Scotch ore. It is a hard hematite that yields about 60% in iron, and is non-Bessemer. No timbers are required. So much ore is left that there is no danger of the mine falling in. It will be seen that the great length of the mine necessitates a change in the plan. The ore all goes to the surface at the east end. The ore must be hauled over all this distance, 1,300 feet from the west extremity. To obviate this they are now sinking a vertical shaft from the surface to strike in the mine at the "knuckle"—the point where the shaft turns down as above explained. The vertical distance to sink is 177 feet. The shaft is $18 \times 6'$ inside. The timbers will have two skips, three even if it be found necessary. No. 3 mine is, naturally, much wetter than the Incline, being deeper and hematite.

Recently they have made a "new find" in the northeast corner of the N. W. $\frac{1}{4}$ N. W. $\frac{1}{4}$ section 11, about 80 rods from the southeast corner of the New York mine. It was found last spring by one of the workmen in his garden. For such service the company allow the men 25 cents royalty on the ore that may be taken out up to a limit of 40,000 tons. They were mining here 25 tons a day when I saw it, but the deposit did not promise to hold out. They were boring with the diamond drill at the east a short way; had already bored two holes across the formation for some length without finding any amount of ore.

The skips usually hold two tons.

The Moro pit, formerly called K shaft, is looking far better now than it was a year ago. Then there was very little ore to be seen in the mine except that found in the south lense, which was reached by a long cross-cut from the shaft through the jasper. Now the ore in the shaft has become a body of considerable magnitude and is good ore. The shaft is 600 feet to the bottom from the surface. It goes down vertically 305 feet, when the ore was cut, then it

inclines to the west at an angle of $45^{\circ} 10'$. The bottom is in rock. The ore lies north of it and west—mainly north. In the two levels above the bottom they are stoping in a fine body of hard ore which is reached by short cross-cuts from the shaft.

The deposit is a chimney of ore which starts at the first level north of the shaft, where it is small; it pitches down to the west at the same angle as the shaft and widens and lengthens as it descends. At 50 feet above the bottom—550 feet from surface—the ore is 50 feet wide and they have opened a length of 60 feet carrying a stope 70 feet high. In the level above they will soon drift to the top of this stope which they are now working to secure ventilation. The pit will furnish 25,000 tons of ore next season easily. The shaft is a long distance from the main engine house and still further from the main pumping building to the shaft, the latter about 2,000 feet. Until recently the pump at K shaft was worked from the main pump by wire rope transmission. The plan has not proved satisfactory and has been abandoned; instead an independent pumping plant has been placed at K shaft and a building constructed there for the purpose. A fine brick smoke stack is among the things erected in the past year at K shaft.

THE CLEVELAND HEMATITE mine, owned and operated by the Cleveland Mining Co., is in the company's estate contiguous to the city of Ishpeming, but a mile north from the north limit of the mines just described. It is one of the important mines in the series of what comprises the Teal Lake range. It has been a valuable mine, but is not looking as well just now as it has formerly. They have really at present but one lense of ore and that is shortening somewhat. Besides the distance from the shaft has so greatly increased that it is very expensive to reach the ore, making its comparative cost heavy.

The shaft is vertical 500 feet deep and the bottom is 500 feet north from the ore. At 355 feet deep, the distance to the deposit was 230 feet. At 405 feet down it was 395 feet. All this long distance through the rock must be tunnelled. A vast amount of drill work—which cost \$20 per foot to drive—with hand drills, the only ones they have employed until lately. Now they are working a compressor and four power drills and must be able to cheapen this rock work, which seems to have been excessively costly. The compressor was put in in December, 1886. They have also put in a new plunger pump, Knowles' new duplex which "throws" the water from the bottom to the surface. The ore body at the bottom of the mine has a width of 60 feet and a length of about 70 feet.

The method of mining described in my last report has been modified in the past year, and the change seems to be a good one, and altogether the plan of

mining now in operation is well adapted to the purpose. The modification consists in using timber sets to serve a temporary purpose. The whole method in brief is as follows: The shaft is sunk a level below the one on which they are stoping and the cross-cut to the ore is made. The two cross-cuts are connected by winzes about 60 feet apart, one on the foot and one on the hanging wall side, through which to run down the ore into the tram cars in the lower drift that takes it to the shaft. It may be well to state that the main drift cross-cut crosses the ore near the end of the deposit, and the winzes are sunk one at foot wall and the other at hanging wall side. From the main entrance a drift extends east and west on either side of the ore, in fact is made to surround the ore following near the the rock entirely around it. The drift is on top of the ore, close up under the filling above. Then parties on each side of the ore body working from the two drifts advance towards each other across the ore, commencing at the far end.

They take off a cross stope drift seven or eight feet wide and put in the sets, tramming the ore to the drifts and thence to the shutes through which it descends to the cars, 70 feet below, whence it goes to the shaft and up to the surface. They thus cut off the top of the ore, working off these sections from the far end in succession towards the main drift.

The object of the timber sets is to hold up the back so that all the ore can be got. When, heretofore, they worked under the filling without timbers they lost some of the ore, now it holds up long enough to let them get it all out. The timbers are very light, just strong enough to suffice for the purpose. They are expected to crush in when the ore is gone. They use no filling, but let the surface come in, follow them down. The stopes are under this surface crush. The ground above comes down soon after they have worked the ore out from under it. Heretofore, before the timber was used, this top came in too soon, now it holds up till the ore is all out.

Some years ago they had two deposits here, designated as the north and the south veins, now there is but one, the south deposit. It is a very soft clay-like ore, which sometimes runs like a partial semi fluid. Ordinary methods of mining do not suffice for such deposits as this. There is employed at the mine a force of 65 men, under the immediate supervision of Capt. Geo. Williams.

As everywhere else about the Cleveland, the Hematite has everything in good shape, engine house and hoisting plant, compressor and pumps, all that is required.

There are now, January 10, 7,000 tons in stock in the mine.

The several mines or pits of the Cleveland Co. produced last year as follows, from Nov. 1885, to Nov. 1886:

Name.	Tons.
Incline Pit.....	78,788
No. 3.....	62,853
Moro.....	18,477
Serammus.....	972
No. 4.....	1,174
Hematite Mine.....	41,117
Total product.....	203,386

That taken from No. 3 pit was 92% Scotch ore.

The Incline pit ore is very hard specular, that has always been liked by furnacemen except that it is wearing on the crushers.

The total force employed by the company varies from 500 to 800 men. The men are liberally treated. During years of acquaintance and observation at the Cleveland mine I have failed to detect any just cause of complaint by the men, in fact complaint is seldom made. The Cleveland, in common with the Lake Superior and other leading companies, has decided to raise the wages of the men 15%, to take effect the first of March. This is one of the results of the increased prosperity of the iron trade.

Three men have been fatally injured in the company's employ the past year.

The officers are Fred. A. Morse, Sec. and Treas., Cleveland, O.; D. H. Bacon, Agt., Ishpeming, Mich.; James Williams, Mining Captain.

The Cleveland Co. has shipped annually as follows:

Year.	Tons.	Year.	Tons.
1854.....	3,000	1871.....	142,658
1855.....	1,444	1872.....	151,724
1856.....	6,343	1873.....	133,265
1857.....	13,201	1874.....	105,855
1858.....	7,909	1875.....	129,881
1859.....	15,787	1876.....	145,661
1860.....	40,041	1877.....	151,554
1861.....	11,794	1878.....	143,320
1862.....	40,334	1879.....	113,108
1863.....	46,842	1880.....	187,234
1864.....	49,954	1881.....	197,843
1865.....	33,355	1882.....	204,341
1866.....	42,680	1883.....	218,219
1867.....	75,864	1884.....	224,479
1868.....	102,112	1885.....	218,632
1869.....	106,133	1886.....	203,386
1870.....	133,884		
Total.....			3,495,028

ANNUAL REPORT OF THE
THE LAKE SUPERIOR IRON CO.

Enjoys the reputation of being one of the best managed mining companies in the State, conservative and yet progressive; nothing of possible value in mining escapes the attention of the Lake Superior management, and, when of assured advantage, no innovation is rejected. The Lake Superior Company is a powerful corporation; its estate is a very large one, comprising about 20,000 acres of land, among which are some of the best portions of the iron region. It has an assured future for long years to come, for, as the ore becomes exhausted at one point, other deposits are almost certain to be found elsewhere on the property, lying as its land does contiguous to the best mines in the Marquette district. The mines which are now operated by the Lake Superior Co. are in the city of Ishpeming, in land adjoining the Cleveland, Barnum and Lake Angeline mines.

The Lake Superior Co. produces annually the largest amount of ore of any company in the State and its aggregate product exceeds that of any other.

The good fortune of the Lake Superior Co., arising out of the position of its lands, is illustrated by very recent developments.

At the Detroit mine, that company has extended its underground workings west until they have encountered the line of lands owned by the Lake Superior Co., a survey of the mine which has just been made having established this fact. The Lake Superior Co. is preparing to open a mine west of the Detroit. They are now placing suitable machinery and will soon sink a shaft. Thus the fact of the extension of the ore on its property, and the position of the ore, its extent, *i. e.*, its width, were all determined by the work in the Detroit mine. Again, the recent development at the Lake Angeline mine has made it probable that the ore in that mine extends west until it passes into the Lake Superior Co.'s land. Acting on this supposition, the agent, Mr. Hall, is now boring with a diamond drill just west of the Lake Angeline mine. At 80 feet west of the line a shaft was sunk 129 feet, and from the bottom several borings were made, the last one of which went into 30 feet of fine ore. The drill was stopped temporarily owing to the caving in of the shaft. At the present writing this work of drilling has been resumed at the same place. The boring now is on an angle north of the former. When satisfied that a sufficient body of ore exists to justify the undertaking, a shaft will be sunk.

An interesting feature connected with this work—in this and the Lake Angeline mine—is, that there is found to be a dike of eruptive rock—a variety of dolerite, probably diabesite—extending east and west, north of the Lake Angeline mine and across the Lake Superior Co.'s lands. Its width is about 100 feet and they have proved it for a length of 600 feet.

The most important mine of this company now is the HEMATITE, which lies south of the hard ore mine and west from the northwest corner of Lake

Angeline. The extreme length of the underground workings in this mine is 1,400 feet, and the maximum width is 360 feet.

Formerly they had two veins, or the deposit was so designated, the north and the south vein. The former had its foot wall on the north and hanging on the south, the south vein having its walls in the reverse order. Now the ore is mainly in one body, the mine having reached the bottom of the fold of which the two veins formed the upturn. In the widest place of this trough the ore is about 150 feet on the bottom, and 200 feet wide across the top, with a height of forty feet. These vertical sections of the ore body are in the form of a trapezoid, generally, but some of them are in the shape of a triangle with vertex down.

The mine is extending east, and borings made with the diamond drill east of the mine show the existence of the ore still further on, but so far as determined in that direction, it seems to lay very flat, and to be in comparatively thin folds. In my last report I mentioned that a new shaft would be sunk near the main line of the Marquette, Houghton & Ontonagon railroad track. This work has been undertaken and completed. It is vertical, single cage, and 1,200 feet from the engine house, and 600 feet east from No. 1 shaft, and 444 feet deep. Between these two shafts the mine is opened up in rooms. The rooms are numbered from No. 1 shaft east, and also to the west of it in the order in which they occur. The rooms are two "sets" of timbers wide—18 feet—each set being 9 feet, and between is a pillar of ore also 18 feet. There are 25 of these rooms laid off, in 20 of which work is progressing now, eight of them west of No. 1, and the rest are to the east of it. Their method is to run a drift along both walls of the deposit, and to lay off the "headings" from these drifts. Commencing in the bottom level they cut the heading through the ore across the deposits two sets wide, one of which is filled with rock and the other strongly timbered, to be kept for a tramway out to the main drifts. On these as a floor the back of the heading is stoped to the height and width for two more sets, the ore being run down into the cars in the cross-drift below. As they rise up with the sets in succession, the "mills" for running down the ore are built up at suitable distances apart. When they start to stope out the third tier of sets, they at the same time commence to fill up the second, so that as the third are completed across, the second are filled up. There is but one line of sets across the vein open at a time. The mine is solid, either with ore or rock.

The rock for filling these openings is brought down from the surface. They are now making a shaft about midway between the two, used for hoisting, for running down rock and timbers into the mine. It will be seen that when a room is stoped out it will be filled with rock from the bottom up, and the

plan is that all the headings that shall be made in the mine shall be thus filled. After the rooms are filled, then in turn the pillars can be attacked, and the ore removed precisely in the same manner as before—as fast as a line of sets is made through the pillars those below it will be filled up with rock. The filling will stand as well as the ore does. The timbers are heavy and well put together. Great care is exercised to place them right, and to stay them well against the walls of the vein, and against the pillars of ore. They are set one over the other in perfect line, vertically, and the caps are equally in straight, horizontal line, and they all hold their place excellently well.

The ore is very soft, and will not stand when left to itself. It, of course, being in a broad synclinal, lays very flat in the bottom, as does also the roof. In advancing the stopes the ore will not generally remain in place long enough to advance the length of a cut. To keep it from falling on the heads of the men they run lagging ahead over the cap. Sometimes they put in a “false set,” *i. e.*, upright and cap of light timber, half the distance between the posts.

The greatest trouble experienced is in “taking up” the timbers in the workings formerly made, before the present system was fully formed and acted upon. It is the plan to have the entire mine on the system now pursuing. The old workings and the old timbers do not conform to the new system. However, the Captain is taking out these old timbers and substituting the new sets in good shape. It is only a matter of care and patience. The best part of the mine is the portion between the shafts. It is completely opened. They have gone to the bottom of the fold, 445 feet down, and have most of the ore above to take out. A large product can be made if desired—at least, they have a great amount of ore in sight. Another shaft, No. 3, will be sunk still further east. Its location is not yet fixed, but it will be beyond the present openings of the mine.

The ore is of good quality, about 63% in iron, and .068% to .085% in phosphorus.

In going through this mine one is impressed with the magnitude of the mine, and with the general excellence of the method of mining as adapted to this kind of ore, and with the thorough and systematic manner in which the work is done. The great advantage of the cage is also noticeable. I was present at the bottom when the men were brought up at noon. It was quickly and safely done, and there was no tiresome climbing of long ladders, and loss of time. The men knock off five minutes to 12 before the whistle, and are soon transferred to the surface. The electric bell is used in signalling in this, and all through the mine. It proves of great advantage.

In the hard ore pits they were mining in Nos. 2, 3, 7, and in A shaft. The

former is the chief hard ore mine. They are working in ten levels, but the bottom just now does not afford a very promising outlook for the long continuance of the pit in the downward direction. The lowest is the 720 foot level, which has just been reached. The 640, however, is fully opened.

There are no new features beyond those described in my last report. The most significant fact is that they have stopped sinking No. 2 shaft. This has not occurred in many years before—not since the shaft was started. It is not stated that the shaft has reached its final depth; it may be sunk lower, but the work is crowded. The deposit has become short and narrow, with a good deal of jasper. The present length is only about 150 feet, while at the 480 foot level it is now above 600 feet long.

The best stopes are in the 480 foot and 520 foot levels, though this matter varies from month to month. There are fine stopes in this mine, but the bottom is short and narrow, and presents no encouraging features. No 3 pit is better, it is working west along the Barnum line, having good stopes in the west ends of the 360 and 417 foot levels, and is first class ore.

A chimney of ore between No. 2 and No. 3 has opened finely in the 480 foot level, and No. 3 shaft is sinking to mine it. The length of the level in this chimney is 100 feet, and its width 50 feet.

They find in the No. 3 pit, a gray ore which is somewhat high in phosphorus, but makes with A shaft ore a separate grade. All the other hard ore is first and second class. In these two pits, Nos. 2 and 3, 10,000 to 12,000 tons of ore per month are mined.

No. 7 pit was also, some years ago, a fine mine, but it has fallen off greatly. The shaft is down to the 480 foot level. The bottom is looking better than the mine has done above, lately. It furnishes about 1,600 tons per month. The dip is north.

"A" shaft is 287 feet deep below datum, 230 feet below surface. There is only one level, about 200 feet long, varying from 10 feet to 30 feet in width. The dip is north 60°. Are sinking for another level.

At the Hematite mine the pumping plant has been removed to the old engine house to give needed room to the hoisting machinery, which has been fitted up.

Mr. Sturtevant, the mining engineer, has constructed a table of elevations showing the height of all important points above or below the datum of the engine house floor.

The force employed is about 600 men. The wages have been raised by voluntary act of the company 15%, to take effect March 1.

The officers are Joseph S. Fay, Jr., treasurer, 37 Franklin street, Boston, Mass., C. H. Hall, agent, Ishpeming, Mich.; John McEntee, mining captain;

Hard ore mines, James Trebilcock, mining captain; Hematite mines, H. B. Sturtevant, mining engineer, etc.

The amount of No. 1 hard ore furnished in 1886 was as follows.....	144,702
Essex ore.....	23,642
Hematite ore.....	98,191
Total.....	268,035

The hard ore sold at the mine last year at an average of \$3.75 per ton, the hematite ore at \$3.00.

It speaks a good deal for the care for the men that is taken by the officers in charge and for the safety of the mine, that in the past year but one fatal accident has occurred, and this in a mine that produces the most ore of any mine in the State and is one of the oldest and deepest. They also had but one fatal accident in 1885, which occurred July 7th, 1885. The one first spoken of happened March 6th, 1886. So that at the date of this writing, February 1st, 1887, there has been but one fatal accident in the Lake Superior Co.'s mine in a period of nineteen months out of a force of 600 men, and the mine working constantly day and night. Both men were killed in No. 3 shaft, and these two are the only fatalities which have occurred in that mine in a period of thirteen years.

Lake Superior mine yearly products:

Year.	Tons.	Year.	Tons.
1858.....	4,658	1873.....	158,428
1859.....	24,668	1874.....	104,311
1860.....	33,015	1875.....	119,365
1861.....	25,145	1876.....	110,570
1862.....	37,704	1877.....	127,349
1863.....	78,976	1878.....	104,674
1864.....	86,773	1879.....	174,747
1865.....	50,201	1880.....	204,094
1866.....	68,002	1881.....	252,235
1867.....	114,935	1882.....	296,504
1868.....	105,745	1883.....	200,799
1869.....	125,560	1884.....	204,796
1870.....	166,582	1885.....	226,040
1871.....	158,074	1886.....	268,035
1872.....	145,070		
Total.....			3,837,088

THE PITTSBURGH AND LAKE ANGELINE COMPANY

is one of the old companies, that holds in fee simple a valuable estate and is now operating one of the best mines in the State. The present mine is comparatively a new one, as it was opened only four years ago. It lies west a few hundred feet from the old open pit workings, wherein the company mined for so many years. It seems now a little surprising that the mining captain had never gone into the west with an exploring drift, and discovered this ore long before. It was found by a deep test pit, sunk many years ago, and used as a well, but the ore was thought to be mixed. In 1882 the pit was enlarged into a shaft, and this body of ore was found to be of great magnitude, and the ore of the best quality.

The mine was described in considerable detail in my last report; but important progress has been made in the past year. As then stated, the mine lengthens to the west, due to the pitch of the ore lens in that direction.

The greatest length of the mine, east and west, is on the second level, which is 1,500 feet. It may be said that the ore exists in the mine in separate lenses, the west one of which is hard ore, which pitches to the west at a very upright angle. The second lense is a brown ore that pitches westerly under the hard ore. The third lense is blue ore which inclines beneath the former, and the fourth is a yellow ore, which lies the furthest east, and underlays to the west the blue ore. This westerly inclination applies to the ore lenses, which are said to "pitch" in this instance to the west. The dip of the formation is north.

These lenses are separated one from the other by spaces of rock. The rock intervening between the blue ore and the brown is 150 feet. The latter was the first that was opened into, and the others have been subsequent discoveries. The yellow ore has been found only recently. It has been proved to a width of 60 feet. It was found in the first level but a short distance in north from the open pit. The color of the ore varies to a reddish tinge in the second level. It is quite different from the other ores found in the mine, both in color and as to quality. It is about at the Bessemer limit, but is low in iron—below 60%.

In the last year a third shaft has been started and is still going down. This shaft has one important distinction; it surpasses every other in size, being 38'x42' outside measurement; it is divided into six compartments—2 cages—pump, ladder, timber ways. It is only, at present, to the second level, 200 feet deep. It is far in the foot wall at the west end of the mine and is sunk to reach the hard ore deposit. It is south of the ore in the mine 100 feet, and they are cross-cutting the formation to reach the shaft from the mine. South and west of the shaft is a body of hard ore that has been found with the diamond drill. They bored through 100 feet of this ore. They found hard ore

first in the second level and have followed it, are still in it, having stoped along the foot wall west, and are drifting to the body of hard ore found by the drill, which lies west and south from the shaft.

This hard ore is very rich; it averages—the average of many analyses— $67\frac{1}{2}\%$ in iron and $.022\%$ in phosphorus. There are a few feet in thickness of ore lying on top of the main body, which is equally low in phosphorus as the other but is also 3% lower in iron. This ore carries about that percentage of silicate of aluminum.

The hard ore has been mined to but a limited extent. They expect to reach the main body of it and to have it opened fully by the time the new shaft is completed and in readiness to hoist.

The A shaft, which is the main shaft of the mine, is vertical, is 400 feet deep to the sixth level. B is to the fifth; it is in the foot wall, south and east of A shaft, its angle of dip to the north varies, being 62° to the fourth level and thence 70° . It is now used mainly for timber, etc.

The ore, blue ore, is the best; it averages 67% in iron and $.034\%$ in phosphorus. The length of the levels in this deposit is 300 feet, and the average width 20 feet to 25 feet. The brown ore has a great width; in the first and second levels it is 180 feet wide, and in the fourth and fifth it is 160 feet.

In the sixth level it has not opened fully yet to show the width, but it shortens somewhat on the west owing to the upright position of the hard ore, which overlies it. From 300 feet it has shortened to 150 feet, while the width does not much vary.

The mine is thoroughly opened. From the fourth level down but a small portion of the ore has been removed. Drifts have been opened through the ore at the points where many of the headings will come, and thus made ready to stope. There is probably standing in the mine from the bottom level up, a million tons of ore.

The method of mining was explained last year, but a modification is now included. The rooms are 20 feet wide and 40 feet high, timbered up four sets high and two sets wide. The pillars between the rooms are 18 feet wide. The levels being about 52 feet. There are also left between the top set and the floor above 12 feet of "back of ore." They are now to some limited extent removing the ore pillars by first filling the rooms, after which they drive a tunnel through the pillar lengthwise, then enlarging the drift on one side sufficiently for a set of timbers. They stope out from the other side of the drift in the same manner and put in the second set of timbers. After advancing the length of a few sets in the pillar they leave some of the ore—the length of two sets—and go on in the drift beyond it and stope out either way as before to the filled room and put in the sets. After the space opened in the pillar has been filled, then the ore which was skipped by is also mined out. The material

for filling is obtained from the old open pit into which the mine has been opened at the second level. In some parts of the mine, when the surface is not needed, the top is left to come in and filling in these places is not resorted to.

The ore in all parts of the mine is tested continually and they work out these headings, which are sufficiently low in phosphorous. Mr. Carl O. Lagerfelt, the chemist employed at the mine, collects samples from every stope three times a week and weekly from the stock pile and analyzes them. Three hundred and fifty analyses have been made by himself and others of this ore in the past six months. Many of these analyses were made at the office of the State Geologist in Marquette.

To the machinery the company has added in the past year a compressor, Raud, 18" x 32," which runs six drills; they are used in sinking the new shaft and in driving the rock tunnel towards the hard ore. The main hoisting machinery house is of stone, and the plant is as fine as any in the country of its power—six winding drums—each six feet diameter—two of them for each shaft. The machinery is the manufacture of the Iron Bay Foundry, Marquette, Mich. The estimated product for 1887 is 175,000 tons of ore. The new compressor house is of brick. Through the resignation of Capt. Harvey Diamond, so long superintendent of the mine, Thomas Walters has been promoted to the command. He has previously proved his efficiency for the position both at this mine and at others where he has held charge.

The mine is within the limits of the city of Ishpeming, west from Lake Angeline and along the south margin of the water. At one-half mile east of the mine, in the south margin of the lake, some ore has been uncovered.

The yearly product of the mine has been as follows :

Years.	Tons.	Years.	Tons.
1864.....	19,500	1876.....	22,589
1865.....	20,151	1877.....	19,113
1866.....	24,073	1878.....	28,161
1867.....	46,607	1879.....	25,420
1868.....	26,651	1880.....	14,794
1869.....	39,644	1881.....	18,000
1870.....	53,467	1882.....	14,518
1871.....	33,645	1883.....	27,259
1872.....	35,221	1884.....	87,018
1873.....	43,933	1885.....	111,051
1874.....	30,499	1886.....	131,384
1875.....	30,281		
Total.....			903,040

Alfred Kidder, Esq., Agent, Marquette, Mich.

THE IRON CLIFF CO.

is one of the strongest and most conservative mining corporations in the State. The company was organized in 1864 with a capital stock of \$1,000,000, divided into shares of \$25 each. Among the corporators were some very distinguished men—Samuel J. Tilden, William B. Ogden, *et al.* These gentlemen purchased the lands, lying in Marquette county, of the St. Mary's Ship Canal and Mineral Land Co., comprising 38,000 acres in round numbers.

Two years later, through the absorption of the Pioneer Iron Co. by the Iron Cliff, the estate was increased to 40,000 acres. It is needless to state that comprised in these lands are some, undoubtedly, among the most valuable mineral lands in the State. The estate is so large and covers so much of the mineral range that there is always a probability of finding deposits of ore within its borders.

For twenty years the company has been an iron manufacturer as well an ore producer. It has operated continuously since 1866 the Pioneer furnace of Negau-nee, the oldest on the lake. Its mines are the FOSTER, BARNUM, SAULSBURY and PIONEER. In addition to the above there are several old openings made by this company, which have long been abandoned. Of these are the TILDEN and OGDEN, situated respectively on sections 13, 23 and 24, T. 47, R. 27. The OLD PARSONS, CLIFF PARSONS, section 21, same town and range. The MILLER, from which some ore was shipped the past season, taken from the old stock pile, mine joins the Old Parsons.

The oldest mine is

THE FOSTER,

which has been worked since 1865. It is situated in sections 22 and 23, T. 47, R. 27. The ore is a soft hematite, not of the first quality, *i. e.* averaging about 53% in iron and .094% in phosphorus. It makes a desirable mixture for the manufacture of car wheels and similar grade of iron, and is mostly used at the Pioneer furnace. The mine is looking better now than it has for some time past. The company is working one shaft in which an additional lift has been sunk in the past year; it is now 350 feet deep. This pit is under ground, no timbering being required, as the ground stands sufficiently well to hold up by, leaving a proper amount of pillars.

The product the last year was 5,544 tons, and the aggregate production is 154,336 tons. General Manager, A. Maitland.

The most important mine of the Iron Cliff Company is

THE BARNUM,

situate in the west part of the city of Ishpeming, adjoining the Lake Superior

mine. "The Old Barnum" was opened in 1868. It is close to the line, which separates it from the Lake Superior Company's No. 3 pit. It has become of very small dimensions, but still the company continues to work this mine, and obtains from it annually a small amount of ore—in 1886, 11,144 tons. They are working along the line to the west. The trouble is that the stopes are getting too far from the shaft, etc., and it costs too much to obtain the ore. It seems a doubtful enterprise to sink a new shaft, but it may have to be done. The ore from this mine is specular, and of excellent quality, first-class, non-Bessemer, hard ore.

North from this mine, across the valley through which run the lines of the railroad, on the slope of the hill opposite, is the

CLIFF SHAFT,

until recently known as the New Barnum, or A and B shafts.

This mine has at least one pleasant feature. It is an easy mine to examine, although it is 472 feet to the bottom level, with a winze 96 feet further down, and 1,400 feet in length. The shafts are vertical. B, the west one, is 420 feet deep. They are double cage, and are connected under ground, so the mine is easy to enter, or to get out of, as you ride in the elevator, and it is airy and well ventilated. These facts are important matters in operating a mine. Men like to work in the Cliff for these reasons. To illustrate: The mine was idle two months in 1886. The miners were scattered over the country, working in other mines, mainly in new hematites. When the company had decided to resume mining work, it gave notice of the fact through the papers, and at the proper time nearly every one of the former hands was on hand to resume his old place.

The shafts have not been sunk any additional distance for two years. The shafts are $834\frac{2}{3}$ feet apart, center to center. The underground workings reach west from B 70 feet, and east of A 500 feet. There is a good deal of water, 500 to 700 gallons per minute, in the two shafts.

All below the main level is full of water, above it are two levels. In these they are mining ore, at the present writing, Jan. 18, 4,000 tons per month. This product will be increased, if possible, to 8,000, as it certainly must in order to realize the estimated product of 80,000 tons for the ensuing year's shipments. The total force employed is 200 men, which number will also be added to.

The ore body is in a synclinal, and the shafts at bottom are a little way north of the lowest line of the trough.

The cross-cut through the ore is 157 feet long in the first level, north and south, while in the bottom it is but 70 feet.

At both ends of the cross-cuts the ore upturns. A fine illustration of this change in the direction is seen in the upper cross-cut, where, for a length of 100 feet, the surface of the overlying rock is exposed finely, showing the curved surface down to the bottom of the fold, and then up the other way.

At one place in the mine, the whole side on the foot wall is polished as smooth as glass.

West from A shaft 110 feet, is a crossing of soap rock, which is found in both levels, narrowing as it goes down, being 30 feet in the bottom and 45 feet wide in the top.

Capt. Sedgwick states that the drill rods when passing through the ore are highly magnetized, while before or after reaching the ore belt, they are much less so.

East of A shaft there is an abundance of red ore, somewhat like the Scotch ore in the Cleveland No. 3 pit. In places the ore makes wide, but it again narrows up, and is frequently headed off by jasper.

In the first level a cross-cut north, after reaching the ore, they find that instead of the expected upturn in the ore, it goes off flat to the north, favoring the supposition that the formation makes an anti-clinal, going down again a little further north; or possibly it is simply a flattening in the upturn. The ore here is only 4 feet wide. Generally the ore has a good width, but it cannot be depended on; that is, it neither holds in size nor in purity; it becomes cut up with soap rock and jasper. There is a good deal of ore to be seen in the mine—some good stopes—but there is rock everywhere as well as ore. The rock cuts out the ore or mixes with it to such an extent as to make it slow, troublesome work to mine it, to effect a complete separation of the ore and rock. This is illustrated by the fact that the company had accumulated a stock pile of 2,300 tons, which was found to be unsalable. It was sold recently to the Cleveland Iron Company for about the cost of mining. An average of this stock pile gave:

Metallic iron	53%
Phosphorus .....	.097%
Silica	4.03%

This was the red ore of low grade.

The following analyses are of samples of the ore from every stope in the mine:

Metallic Iron.	Phosphorus.	Silica.
66.159 per cent.	.100 per cent.	2.21 per cent.
60.74 "	.127 "	3.44 "
64.58 "	.093 "	2.20 "
50.13 "	.122 "	2.12 "
58.03 "	.078 "	2.12 "
64.02 "	.105 "	1.42 "
60.514 "	.098 "	2.39 "
65.93 "	.125 "	1.89 "

At 140 feet south of A shaft, it is 300 feet from surface to the ore; at 650 feet south, it is 120 feet.

B shaft is 420 feet deep. At 700 west of it, it is 520 feet to the ore. At A shaft the dip is south; at B it is north. The dip is about 4 to 1.

They are building a new house over this shaft.

The Barnum has produced each year as follows:

Year.	Tons.	Year.	Tons.
1868.....	14,386	1878.....	26,680
1869.....	37,503	1879.....	24,911
1870.....	44,793	1880.....	24,921
1871.....	45,939	1881.....	27,281
1872.....	38,381	1882.....	41,424
1873.....	44,368	1883.....	62,752
1874.....	40,255	1884.....	67,782
1875.....	40,914	1885.....	47,458
1876.....	37,750	1886.....	82,686
1877.....	38,314		
Total.....			788,743

Wm. Sedgwick, superintendent, Ishpeming, Mich.; Tom. Barge, clerk, Ishpeming, Mich.; Alex. Maitland, general manager, Negaunee, Mich.

The Iron Cliff Co. shipped 1,716 tons of ore from the OLD MILLER mine, an abandoned location, but having an old stock pile of low grade ore.

THE PIONEER

is a new mine in the N. W. $\frac{1}{4}$ S. W. $\frac{1}{4}$ of Sec. 4, T. 47, R. 26. The opening is close to the west line of the property. In fact it is a continuation of the Mitchell mine that was found and explored in the adjacent 40 to the west.

Work began here last summer. I first visited it in August. They had just begun the work of stripping the ore and of preparing to stope it. Now, after about five months, they have a pit 200 feet long east and west, and at the deepest point it is about 85 feet down. The ore body is, apparently, about 30 feet wide; though it does not seem to be altogether clean, *i. e.*, free of rock.

They are at this time—winter—further removing the capping of rock, getting ready to stope in the spring at the opening of the shipping season.

The ore is a good quality of hematite, that proves to be Bessemer so far as the analyses have been made to test it. The dip is to the south; further west, half a mile at the Buffalo, the dip is north.

The pit is on the section line 600 feet south of the $\frac{1}{4}$ post. The product shipped the past season was 5,140 tons. Alex. Maitland, general manager of the Iron Cliff Co., directs the operations.

The company has done no work at the SEC. 12 MINE the past year. But at

THE SAULSBURY MINE

operations have continued as usual, with the usual excellent success. The Saulsbury has been a good mine and still remains such. For a small mine it furnishes a large product of good ore at a moderate cost. The mine lies on the south side of the high greenstone bluff that separates it from the Lake Angeline. Formerly the mine consisted of two great open pits that were worked out to considerable depth and width, close to the greenstone. Now there is little doing in the open pits, but the ore all, or substantially all, comes out of a shaft that descends into a deposit situated south of the old pits about 200 feet. The shaft is 360 feet long. It is somewhat unique, as it has several bends. The skip road descends from the ore pocket and elevated track, to the north to reach the mouth of the shaft, thence it goes down vertically to the first level where it again changes its direction and descends to the south at an angle of about 45°.

The ore reached by the shaft is in two lenses lying parallel with each other east and west. The north lense is non-Bessemer ore and the south one is Bessemer. Of course they are naturally bothered considerably for hoisting facilities. The one crooked shaft—single skip—is inadequate to sending up a large product, especially when the same shaft has to be used for taking down the timber into the mine. They plan to sink another shaft further south but have delayed, awaiting until the ground in that direction has been more fully explored that the position of the shaft may be determined with reference to the future working of the mine to the best advantage. A drift has been started south. The rock

through which they are cutting is identical with that of the whole formation in which the ore is found, a broken jasper. This cross-cut is 55 feet long. It was begun and stopped some time ago, and as soon as the new compressor is ready to work it will be again pushed forward—more rapidly with the aid of power drills. An addition has been made to the engine house for compressor room and the machine is nearly ready to work.

The mine has improved in the bottom; certainly it looks as well as it did a year ago. There seems to be less rock. This bottom level has not been stoped in yet much, but has been recently opened. They have drifted 50 feet each way east and west from the shaft and cross-cutted the ore 50 feet to the rock which separates this lense from the Bessemer ore south of it. The Bessemer deposit in the level above was 50 feet wide and 250 feet long; the north deposit has about the same width and is 350 feet long. In the bottom they have not crossed to the Bessemer ore yet.

The formation between the high ground both on the south and the north holds these pockets by ore, which, if not very large, are very good indeed. The openings under ground are timbered after the Nevada system, and the mine is made entirely safe.

During the winter they are scrambling in No. 2 old shaft. It goes down to the north on the side south of the open pit and thence goes under ground, in all, its depth is 200 feet. Also in No. 3 they find a little ore, which a few men are now working out. It is 275 feet deep.

They make two grades of the ore, Bessemer and non-Bessemer. The former is about 18,000 tons, though Capt. Buzzo thinks the product will increase to 25,000 tons in 1887. They are working in two levels and will soon sink for another; will begin when the compressor is ready to work. The ore in stock—January 24—8,000 tons at the mine.

The Bessemer ore analyzes about 60% in iron, and .040% phosphorus. The whole mine averages about 60% ore. It is said to grow cleaner as they go down.

The local officer in charge is Capt. Thomas Buzzo. Mr. Alex Maitland General Manager Iron Cliff Company.

The following table shows annual product:

Year.	Tons.	Year.	Tons.
1872.....	545	1880.....	22,387
1873.....	11,023	1881.....	41,888
1874.....	6,730	1882.....	42,019
1875.....	4,571	1883.....	17,028
1876.....	20,510	1884.....	23,171
1877.....	37,868	1885.....	29,503
1878.....	52,155	1886.....	51,231
1879.....	39,770		
Total.....			403,734

It will be seen from the above table that the product of last year was nearly double that of any previous year.

At about a mile and a half south and east of the Saulsbury are

THE WINTHROP AND MITCHELL MINES,

now and for a few years past operated by the Winthrop Hematite Company as lessees of the Winthrop Iron Company, and of the Mitchell Mining Company, of these two contiguous mines.

These are working in the same deposit of ore. The line between the properties crosses through the main ore bodies and through the engine house of the Winthrop mine. The Mitchell lies east of the former, and its workings are nearly wholly under ground.

There are three working shafts, the west one of which is designated as A shaft. It is the main shaft of the mine, the one that affords the most ore; is 315 feet in depth, inclining to the north. In the first level 90 feet south-west of the shaft, they have recently found a new deposit, which is 6 feet to 25 feet wide. It runs up to the sand and as the stock pile lies over it, they cannot just at present work it.

Going down to the 165 foot level we find them working in three lenses. In the first one the ore is 40 feet wide, and they are stoping east and west in it, showing well. The other lense is 15 to 40 feet wide, and 100 feet long, and the third is about the same.

In the 217 foot level a drift 100 feet long through rock, going northeast from the shaft, comes into a deposit of ore 20 feet wide; below, the same deposit shows itself to be 54 feet wide.

All this which I have mentioned is new opening. The old openings in this shaft were fully described in my last report.

In the 315 foot level this new ore has also been found, so they are sure of good stopes the coming year.

In the old workings they have standing from the 315 feet level up 60 feet in height of ore, which is 20 to 50 feet wide, with a length of 250 feet east and west. Just at this writing, January 10th, this ore is not available, owing to the water in the bottom of the mine which the pumps are not equal to the task of freeing the mine from. They are gradually getting the water under control, however. The ore obtained from A shaft the past year has been from entirely new discoveries; from these has been mined 25,000 tons in the past year, and it is safe to predict that the shaft will yield no less amount in the year to come. The ore is in sight, only requires mining out. Mr. St. Clair estimates the product at 5,000 tons per month. They do not do much timbering in this mine. The ground stands well when the water is drained out of it. They employ in this shaft about 40 men. Below the 217 feet level they are not working. The old Mitchell mine workings stopped at the 165 feet level.

The most easterly shaft is D; it is 200 feet deep; it is vertical, $6\frac{1}{2} \times 24$. It descends through the ore in the first two levels, but is finally in the foot wall, so that the bottom, in the fifth level, it is 32 feet to the ore to the first vein. They are working about 40 men in this pit also, working in all the levels. In the upper ones they are stoping mainly under the old crush. The workings extend east of the shaft 175 feet, and west they connect with those of C shaft. The lenses of ore are separated by horses of rock. The south lense is blue ore, which in the bottom level is small; it has been diminishing in size with each level until it is now about 6 feet wide and 30 feet long. The mine looks better than it did a year ago. It surprises me to find so much ore in sight. They have begun to sink another level. The ore makes north and east, dips north and lengthens east. The width is from 0 to 40 feet, and even wider in places. But the deposit is very irregular. It is impossible to particularize. They estimate that D shaft will give 20,000 tons of ore the coming year.

West from D is C shaft. It has been sunk an additional lift in the past year and is nearly connected with D in the third level and in the fourth. Just now they are delayed owing to repairs going on in the shaft. There are six levels in this shaft, one more than in D. The three upper levels are nearly exhausted. In the bottom level they have drifted to the north ore, but have not "opened up" in it yet. In the fifth, the ore was 80 feet long and 20 to 30 feet wide. The ore body does not appear to be diminishing in size at least. The cross-cut to the ore is 40 feet and the shaft is 240 feet.

The mining captain is Samuel Roberts; Geo. A. St. Clair, Supt.

The Winthrop mine lies west of the former, embracing the S. W. $\frac{1}{4}$ Sec. 21, T. 47, R. 27. "A" shaft workings and those of the Winthrop open together, "A" shaft being but 278 feet east of the Winthrop line. The most striking feature at the Winthrop is the immense open pit about 300 feet long, 200 feet wide on top and of about an equal depth. To a timid person this great chasm has its alarming features, especially in the night, when standing upon the surface and gazing down upon the busy scene in the bottom, partially revealed by the twinkling lights of the workmen. It presents a weird aspect which tends to disturb weak nerves. The mine does not appear to vary from year to year. It looks now precisely as it did a year ago, notwithstanding that 50,000 tons of ore have since been taken out. The depth is 265 feet to the bottom and the ore has a width of 20 to 60 feet east to the Mitchell line.

The method of mining has been to let the top "come in," taking out all the ore. Now they have begun in the bottom level to room out and timber in sets. In No. 4 shaft they are working three veins which are 10 to 30 feet wide. The length of the mine east and west is 500 feet. At one point the ore is 80 feet wide and then wedges out; coming in again further on with a width of 30 feet.

The mine will produce as much as it did last year, perhaps as ore is higher, they may get out more of it. About 80 men are worked in the mine—both mines employ 250 men.

Geo. A. St. Clair, Supt.; Norick Anderson, Mining Captain, Ishpeming, Mich.

The Mitchell mine has produced annually as follows:

Year.	Tons.	Year.	Tons.
1872.....	197	1880.....	12,750
1873.....	8,552	1881.....	20,964
1874.....	7,699	1882.....	33,394
1875.....		1883.....	
1876.....	5,596	1884.....	29,883
1877.....	3,897	1885.....	7,415
1878.....	4,259	1886.....	42,044
1879.....	11,450		
Total.....			188,106

The ore is non-Bessemer, but close to the limit.

The Winthrop has produced annually as follows:

Year.	Tons.	Year.	Tons.
1870.....	2,469	1879.....	27,050
1871.....	7,314	1880.....	45,247
1872.....	14,239	1881.....	43,900
1873.....	31,150	1882.....	23,259
1874.....	8,248	1883.....	50,143
1875.....	8,642	1884.....	53,077
1876.....	27,236	1885.....	63,915
1877.....	12,549	1886.....	44,274
1878.....	23,740		
Total.....			487,437

THE SAGINAW MINE

was abandoned by the Saginaw Mining Co. some years ago, but some parties have recently secured a lease of the property and are now exploring it. The mine was once a large producer of ore. It was opened in 1872 and closed down in 1883. The total output was 439,328 tons. The ore is specular, but varied greatly in texture and structure, being a fine steely to coarse granular or a slaty ore; but it was all good ore. The mine is in the N. W. $\frac{1}{4}$ S. E. $\frac{1}{4}$ Sec. 19, 47, 27. Adjoining it on the west is

THE ALBION,

another old location, which was opened at considerable cost by the St. Clair brothers in 1871, but soon after abandoned. Recently the same gentlemen have renewed the work on this property, but up to the present writing have not succeeded in finding merchantable ore in any quantity. The ore is specular, and the amount shipped years ago was 1,168 tons. Immediately west in the N. W. $\frac{1}{4}$ N. W. $\frac{1}{4}$ S. 19, T. 47, R. 27, is

THE GOODRICH MINE,

another abandoned location, which parties are again exploring. Shipments were made from this mine first in 1873, and annually thereafter until 1882. The total output was 51,479 tons.

THE NEGAUNEE MINING CO.

is the name of the new organization, which has been made to work the mine east of Negaunee, on the farm of Messrs. Mitchell, Maas and Longstorf, that for the past two year they have been endeavoring to open. The trouble has

been to sink the shafts to the ore. They have two shafts. No. 2 is 250 feet northwest of No. 1. The latter is now 385 feet deep, in fact has reached the depth at which it was expected that the ore would be found. It is likely that the shaft will be in ore at any time. They have had great trouble in sinking to the ledge through the 40 feet of overlying drift. The ground is somewhat low, bordering on the swamp, and is saturated with water and thus made so great pressure as to crush in the timbers, etc., used to line the shaft. No. 2 shaft was sunk through 80 feet of loose drift, gravel and quicksand, and then 30 feet of hard pan clay and gravel. This is the shaft that has given the greatest trouble. The ore was struck at a depth of 165 feet. The ore is Bessemer. Work was first begun here on December 1, 1884, and has gone on without interruption ever since. One of the first things done was to construct an engine house and set up the machinery that was brought here from the National mine, which latter these same parties had decided to abandon.

The shafts are 12'x12' inside the timbers. The worst part of the undertaking is over. They will now soon be in readiness to "open out" the mine and hoist ore. The mine is but a short way from the main line of the M. H. & O. R. R., but being in lower ground, the track is made to follow the valley from Negaunee around by the Buffalo, Mitchell, etc. The mine seems to be a continuation of the Teal lake range.

President, Wm. Chisholm, Cleveland, Ohio.

Agent, etc., Capt. Sam Mitchell, Negaunee, Michigan.

THE BUFFALO IRON MINING COMPANY.

The Buffalo is the most important, as yet, of the new Negaunee mines. Its discovery was a very fortunate one for the parties who made it, since they have recently sold out for \$200,000, from which sum they realized \$125,000 clear profit to themselves. In addition to this they realized a net residue, over and above all expenditures made in opening and working the mine, of \$12,000.

The ore was discovered in June by Geo. Mitchell, and he associated with himself in working the deposit H. H. Milden, A. A. Anderson, and Ed. Lobb. The realty belongs to the Arctic and the Pioneer Iron Companies, and comprises the N. E. $\frac{1}{4}$ S. W. $\frac{1}{4}$ Section 5, T. 47, R. 26. The company now operating the mine came into possession of it by purchase January 1, 1887. The officers are John Paulson, President, Minneapolis, Minnesota; H. H. Stafford, V. P.; C. A. Avery, Sec.; Hugh Ryon, Treas., all of Milwaukee, Wisconsin.

The former proprietors mined and sold 10,860 tons, which they sold at the mine for \$2.50 per ton. The royalty is 25 cents per ton. It is a promising mine. I am inclined to the opinion that the vendors sold out cheap enough.

The deposit is opening up finely. They have now, January 1, about 3,000 tons of ore in stock. The ore is overlaid by about 10 feet of drift, and has a width of 100 feet, following along the foot wall.

There does not seem to be any suitable hanging wall as yet, so that it is impossible to say how wide the deposit may prove to be. They are mining in open cut, about 40 feet deep. The dip is to the north 70° , and the ore runs east and west. They are stoping east in the open cut, and have a drift ahead, 80 feet, of the stope. They are preparing to sink a shaft, and will mine under ground. Have engaged machinery, two 4-foot drums, and engine 14"x24". The company is working, just now, 40 men, under the supervision of Capt. Geo. Mitchell. The opening is at about midway east and west of the 40. There are several test pits to the east and west of the pit, which are in ore. When the shaft is sunk to sufficient depth they will cross-cut the ore and learn more definitely regarding it.

The ore is clean, a soft, brown hematite that cuts like clay, some of it. It analyzes fully 60% in iron, and at about the Bessemer limit in phosphorus.

At half a mile east of the Buffalo is

THE SAM MITCHELL SECTION 5 MINE,

the third in the list of the new mines at Negaunee. As heretofore mentioned, this mine is contiguous to the Pioneer. It is located $1\frac{1}{2}$ miles east of Negaunee on the N. E. $\frac{1}{4}$ of S. E. $\frac{1}{4}$ of Sec. 5, T. 47, R. 26. The mine is about midway of the 40 north and south, and on the east line. The pitch of the ore is west. The mine is underground, mainly, with two shafts. No. 1 is 150 feet west from the east line, and is 175 feet deep. No. 2 is 110 feet further west, and 170 feet deep. They are working in two levels. The two shafts are not connected under ground, but are separated by a bar of dead ground.

The formation bends to the south and the ore now seems to be extending in that direction. They have cross-cutted to the wall on the north, which is quartzite and slate, have found no wall to the south.

The ore in No. 1 is about 60 feet wide—it is mixed with rock but pretty clean in the bottom. The ore stands well. They work it out in chambers and timber. No. 1 shaft goes down vertically 40 feet and then it angles 45° to 50° . They plan to sink a good working shaft in the foot wall. The ore has been traced west 1,000 feet, or rather they have sunk and found the ore in good body at 200 feet east of the west line. They are working a force of 50 men.

They have some machinery, two 4-foot drums, and a pump in each shaft.

The ore is sold to the Cleveland Rolling Mill. It is above 60% in iron and about at the Bessemer limit. The product since June up to close of navigation

was 8,263 tons. A sale of the property has just been made—April—to the Delaware & Lackawanna Coal Co.

Geo. Mitchell, Supt. C. McGregor, Mining Captain.

THE SOUTH BUFFALO

is the name given to a new mine adjoining the Buffalo property on the south, the S. E. $\frac{1}{4}$ S. W. $\frac{1}{4}$ Sec. 5, 47, 26. It is held on a lease by A. A. Anderson, Wm. F. Anderson and Chas. Sundberg. Work of exploration was begun in Nov. last. They have sunk a drill 140 feet, the last 50 feet of which is apparently clean ore, which analyzes above 62.4% in iron, 7.48% silica and .094 in phosphorus. The parties are about starting to sink a shaft following the drill hole. An analysis of the ore made by C. O. Lagerfelt gave metallic iron 63.22%, phosphorus .087%. The ore was taken at a depth of 112 feet.

MILWAUKEE IRON MINING CO.

disposed of a pretty large product last year, as will be seen by referring to the table of products. But, notwithstanding, the mine is still in good shape and affords all the indications necessary to assure the company that it will be able to mine an equally large product the ensuing year.

The dip of the ore is to the south and it pitches slightly west, so that the pits to the east have gradually worked out and the mining has more and more, each year, extended west. In this way the early pits have one by one been abandoned, and now they are robbing No. 7 and the east end of No. 8, as a year ago I stated they were depleting No.s 5 and 6. In No. 7 they are taking out the shaft pillars and will thus get about 3,000 tons of ore.

The west part of No. 8 is good, but in the east end they are removing the ore pillars. The ore now to be seen in the mine is that just mentioned in No. 8 pit and the whole of No. 9. The latter is looking extremely well. It is well opened and is showing fine stopes of ore. Probably there are in sight—January 10—25,000 tons of ore, perhaps more. No. 9 pit is 285 feet deep; the bottom is all of ore. The length is 300 feet east and west, and it is 15 feet to 40 feet wide. East of the shaft the deposit is pockety, while west of it it is more uniform. Until last summer they had mined in open cut, or if under ground, had supported the mine with pillars of ore only, but now they are using timbers, the usual Nevada sets. Last winter the Carmichael Bros., who work the mine on a lease, had it well opened up for stoping in No. 9, but contrary to their former experience, it was found that the ground would not stand when spring came. As greater depth was attained the ore had become softer. The work was at a standstill. There seemed to be no other way but to introduce timbers, which

was accordingly done. The Carmichael Bros., who had contracted to mine the ore at \$1.00 per ton, had based their calculations on following the former methods, and the change became a matter of much disappointment and of loss to them. The coming year the price is fixed at \$1.25 per ton. The addition is to cover the cost of the timbers. They are sinking No. 9 shaft for a new "lift," 70 ft. To sink they follow the plan which I have heretofore described, which is to sink vertically in the ore far enough ahead of the shaft so that when the depth of a level is reached the bottom of the winze will be in the line of the continuance of the shaft. Then they rise up for connection. The object to be accomplished by this plan is to avoid working under the skip, as hoisting cannot, of course, be stopped.

They are sinking a new shaft, going down vertically from the surface. Its location is 305 feet south of No. 9. The depth to sink the ore is 180 feet. The shaft will connect with No. 9 when the ore is reached. It is 6'x10' inside timbers, and 125 feet deep at present writing, January. It is expected that there will be a continuous run of ore between the shaft and No. 9 pit and also to the Wheeling mine line. The Milwaukee has been a good mine from the start; but the lenses have always been short, and like all the Negaunee south side hematites, work out. The ore is of good quality, above 60% in iron. Analyses of samples of the ore shipped give a percentage in iron of 67%, and from .019 to .021% in phosphorus. But the phosphorus is about at the Bessemer limit, of from .040% to .070%.

As previously stated, the ore is mined by the Carmichael Bros., on contract, at \$1.25 per ton, for the coming year, and to all appearances they are conducting as faithfully for the interests of the owners of the mine as if they were working on a salary. The mine is ordinarily a dry one.

The force employed averages 85 men.

The mine is within the corporate limits of the city of Negaunee, about a mile south of the center of the city, in the S. E. $\frac{1}{4}$ S. W. $\frac{1}{4}$ Sec. 7, T. 47, R. 26, and is estimated in about the center of the "40." Alfred Kidder, Agent, Marquette, Michigan.

The Milwaukee has produced annually as follows:

Year.	Tons.	Year.	Tons.
1879.....	941	1883.....	805
1880.....	13,141	1884.....	25,000
1881.....	31,254	1885.....	38,466
1882.....	41,200	1886.....	46,693
Total.....			197,501

BAY STATE MINING COMPANY,

although not an active corporation, has changed hands, and the property will be explored thoroughly the coming year. The estate is the W. $\frac{1}{2}$ N. W. $\frac{1}{4}$ Sec. 8, T. 47, R. 26, in the city of Negaunee. The royalty for the new company has been fixed at 33 $\frac{1}{3}$ c. per ton for all ore sold at the mine at \$3.00 or less per ton, and at 50c. per ton for all sold at a price in excess of that. The new officers are W. S. Coburn, Neilsville, Wisconsin, president.

THE ROLLING MILL MINE

is situated in the "40" adjoining the Milwaukee, and east. The mine cannot be said to have been fully operated for several years past. A limited amount of ore has been gotten out the past year, as will be seen by reference to the table. The controlling interest in the mine is held by Mr. Luther Beecher, of Detroit, and his son, Geo. L. Beecher, is now in charge of it.

The mine has been very fully described in previous reports, and there is nothing new to be added. The annual product has been as follows:

Year.	Tons.	Year.	Tons.
1871.....	236	1879.....	9,637
1872.....	6,772	1880.....	15,172
1873.....	13,112	1881.....	1,668
1874.....	14,796	1882.....	163
1875.....	33,688	1883.....	1,528
1876.....	50,997	1884.....	1,820
1877.....	38,901	1885.....	3,427
1878.....	30,773	1886.....	4,403
Total.....			227,403

THE WHEELING MINE

is contiguous to the Milwaukee, also, but joins it on the west. There has never been much done here. A limited amount of work was carried on in 1885, which resulted in mining and shipping 6,383 tons of ore. The pit from which this ore was obtained is close to the Milwaukee line. No work has been done in the past year, for the reason that is given, that the owners of the lease, who are well-known men residing at Negaunee, do not command the requisite funds to operate the mine. It is a good mine to explore. James F. Foley, Agent, Negaunee, Mich.

THE McCOMBER MINE,

which, after being idle for three years, has passed to the control of a new com-

pany, will be again operated under the name of the LUCY MINE. Men were set to work about the 10th of January repairing the machinery and getting it in readiness to work. The mine is in the hands of men who are abundantly able to operate it and who have other and long connection with the iron mining industry of Lake Superior. It was once an important mine, originally opened in 1870 by W. C. McComber who held it in a lease from the owner, J. P. Pendill. Mr. McComber worked the mine for two years and then sold his lease to the McComber Iron Co., which was organized August 14, 1872. This company operated the mine until 1883, when the depression in the iron business intervened, causing great financial losses to the company, and the mine closed down. The lease having been forfeited or surrendered, a new one was obtained of the Pendill estate by Mr. Wm. H. Barnum, *et al.*, who are the gentlemen comprising the present company.

It is certain that the mine is not without ore, but whether it will prove as productive and profitable as it has been is a question. It was my impression when I examined the mine the last time just before it was finally closed down, that the best stoping ground to be seen in the mine was near the west line joining the South Jackson. The ore here, however, has been found to be higher in phosphorus than it was in the pits to the west. Full descriptions of the mine and of matters of interest pertaining to it will be found in previous reports.

The McComber mine is one of the oldest of the Negaunee hematites, and one of the first to establish the excellence of these ores. There is much satisfaction expressed at Negaunee, within the limits of which the mine is situated, at the fact of the renewed effort to again bring it to the front.

The description of the land is N. W. $\frac{1}{4}$ N. W. $\frac{1}{4}$ S. 7, and S. W. $\frac{1}{4}$, S. W. $\frac{1}{4}$, S. 6, T. 47, R. 26, the mine being a half mile south of the Union depot.

Alexander Maitland, Superintendent; J. H. Rough, Mining Captain.

The following table shows the product for each year:

Year.	Tons.	Year.	Tons.
1870.....	4,856	1879.....	28,962
1871.....	15,442	1880.....	31,028
1872.....	25,030	1881.....	28,230
1873.....	38,332	1882.....	40,390
1874.....	2,642	1883.....	14,676
1875.....	10,357	1884.....	
1876.....	17,282	1885.....	
1877.....	19,691	1886.....	
1878.....	30,180		
Total.....			307,608

Of the other south side Negaunee hematites there is little to be said. None of them has been worked the past year, and all have been described in previous reports. North and west of Negaunee, about a mile and a half, commencing a little way southwest from Teal Lake and extending west, is a series of mines known as the TEAL LAKE RANGE. The most easterly of these mines is

THE CAMBRIA MINE,

which is situated in the S. E. $\frac{1}{4}$ of S. 35, T. 48, R. 27, and is worked by the Cambria Iron Co. The realty belongs to the Teal Lake Iron Co. The Cambria has continued all along ever since it was opened to be an excellent mine. It has afforded each year a product of first-class ore, high in metallic iron and sufficiently low in phosphorus to be suitable for Bessemer pig.

I have visited the mine a number of times in the fall, about the season of the close of navigation, and have invariably found some discouraging features. The bottom of the pit would be rock, or they would be contending with some large "horses" of rock, which had most inconveniently introduced themselves where ore was expected to continue. And again I have as often visited the mine in the spring when it was all opened up for the season's product, and exactly the reverse of the appearance above indicated was shown. There would be plenty of ore to be seen. When in the fall you would wonder where the ore was to come from, in the spring it would be perfectly evident that there was a certainty of an ample product.

It has so happened that I have always found the mine looking comparatively poor in the fall and extremely well in the spring. I went through the mine in December, 1885, and found the old pits practically exhausted of ore. There was little left but some pillars. The bottom was everywhere rock, but I found no apprehension on the part of anyone in charge regarding the situation. They knew where the ore was to come from and were sinking and cross drifting to reach it. The sequel to this, time has shown that their faith was well founded. A product nearly equal to that obtained in any previous year has been shipped, and the assurance for the future was never better than it is now; 40,000 tons were mined in the new shaft. Just now, while there is no rock to contend with, they have a misfortune in another way, arising from a big cave in the mine, which is giving considerable trouble. The new shaft is north of all the old pits, and the ore is north and west of the shaft and is reached by a cross-cut of 70 feet. The ore comes up to the sand, within 30 feet of the surface, and is worked out in rooms to a height of 250 feet. The shaft is now 310 feet vertically down. The rooms are timbered in the usual manner as described last year in the old pits. The rooms are small, as the ore does not stand; it

runs like dirt. No blasting, scarcely picking even is required; it can be shoveled directly out of the stope. The only trouble is to keep the ore in its place. There is no trouble in breaking it. The sets are only 5' 4"x7' high, and it is almost impossible to get these in. They have mined out in the second level a length of 50 feet and a width of 24 feet. In the first level the length is but 30 feet, but they have not gone to the limits of the ore in any direction—ore in the bottom—to the north, west and east.

The timbers, owing to the nature of the ore, gave way and the mine caved in. They are now pursuing at this part of the mine a different plan. To get the ore in this crushed portion they have drifted from the shaft to the west, around the "crush," and rise through the ore to the top and opened drifts, securing them with timbers, through the ore in different directions, after which they cut off the ore with a 9-foot stope carried on top of the ore, letting the ground come in after them, working towards the winze through which the ore is sent down. They thus work off the ore from the top downward. The only part of the old mine in which they are working is No. 5. They drilled east of the shaft through 80 feet of ore, and are now drifting to it, going around most of the "crush." They will be into this body of ore the present winter, and will thus draw upon it for the next year's product. Two hundred and fifty feet north of the "cave" they have sunk a shaft for lowering timber, etc. Are also drifting in the second level from this shaft to the ore to connect with the workings, and have tunneled northwest 160 feet, all the way in ore, the last 40 feet of which is shown to be in ore in large body. At 200 feet down is another drift under the one above, and is cut out in the same ore body.

This ore in the new shaft is equal in quality to any ever found in any of the pits in the mine. Thus the Cambria is sure to be all right, looking better than ever, both as to quantity and quality of ore. There will be no falling off in the product of 1887.

The company is working 157 men.

Capt. Gordon Murry, the Superintendent, whose death occurred early in the year, has been succeeded by J. B. Jeffery, an intelligent and experienced mining man.

Alexander Maitland, General Manager, Negaunee, Michigan.

The mine has yielded annually as follows:

Year.	Tons.	Year.	Tons.
1876.....	6,324	1882.....	47,545
1877.....	10,082	1883.....	47,508
1878.....	3,754	1884.....	59,740
1879.....	6,860	1885.....	50,796
1880.....	7,232	1886.....	59,406
1881.....	18,837		
Total.....			318,148

THE LILLIE MINING CO.,

directly west of the Cambria, is what was formerly called the Bessemer, now the Lillie mine. The estate comprises 70 acres in the S. E $\frac{1}{4}$ of Sec. 35, T. 47, R. 27, and is also owned by the Teal Lake Iron Co., and held on a lease by the present proprietor. The formation has a strike east and west and dips about 45° to the south. It was formerly worked out in two large open pits, having been opened in 1875. In the winter of 1882 they caved in and the ore in the bottom, if any existed, was deeply buried beneath this sand and rock. The mine owners sank through the waste material expecting to find ore, but at the time of my visit a year ago they were feeling somewhat disappointed. However, the mine is looking far better now and the Lillie is in a fair way to be a good mine again. They have sunk a new shaft 200 feet south of the east pit. It is 207 feet deep and from it they have drifted to the ore, in fact have opened a drift in the ore 200 feet and sunk in it 40 feet. The ore body which they have developed between the two shafts—the new shaft and the one north of it that goes down to the south through the bottom of the open pit—is 117 feet north and south and 85 feet east and west. They have a rise in the ore in the 200 feet level that is looking well.

There are two shafts, the new one which is vertical and sunk from the surface in rock, and the No. 1 shaft that has previously also been mentioned; it is 194 feet deep. This will hoist in both. There was a third shaft further west, but the lightning struck it and destroyed it so completely that it was not thought worth while to repair it. The two working shafts are connected, and the ore is opened so as to divide the hoisting between the two. The ore body is wholly south of the old workings. It is a new find, but may be the same ore, its extension south being due to the underlay and a greatly increased widening of the deposit.

The ore is very soft and has no sustaining power; it will run from the stopes unless held in place. They will timber—room out—three sets wide, using

such precaution as becomes necessary and modifying according to circumstances. Altogether the Lillie has come to the front in good shape, apparently looking well enough to assure a product of 25,000 tons the coming year, of which amount about 1,600 tons are now in stock (January 1). There are two four feet drums, and a separate plant will be placed south of the new shaft.

The quality of the ore corresponds with that of the Cambria. The management is in the hands of Mr. Alex. Mitchell, of Negaunee, assisted by Captain Charles Koch.

The mine has yielded as follows :

Year.	Tons.	Year.	Tons.
1875.....	144	1881.....	16,718
1876.....	6,801	1882.....	28,221
1877.....	10,127	1883.....	2,172
1878.....	8,506	1884.....	2,683
1879.....	21,681	1885.....	708
1880.....	18,347	1886.....	3,957
Total.....			122,507

THE DETROIT MINING CO.

The history of the Detroit mine, which is not a very old one, presents great contrasts. Four years ago there was no ore to be seen, the mine was exhausted, while now it is a good mine, and the indications are that it will continue to be a good mine. At first the mine was a small open pit, now it is wholly under ground, reached by a single double skip shaft that descends vertically 245 feet, and then dips to the south at an angle of 45° until it attains a total depth of 350 feet. The shaft is near the east line of the property, and the 300 feet level extends to the west line, a total length of 1,200 feet. The ore runs east and west, or very nearly so, and the workings are clear across the "40," and even over the line west into the Lake Superior Co.'s land. The bottom level—350 feet—is not very much opened, and they are sinking for the 400 feet. The deposit is a good width, ranging from 4 feet to 30 feet. A drift has been made south from the shaft, in the bottom, 374 feet in length, for the purpose of reaching a deposit of ore that was discovered with the diamond drill last summer. The drill was set in the bottom of the mine and pointed south. At the above distance it passed through 58 feet of ore, which was found on analysis to be Bessemer. It was expected that the drift would intersect the ore at any moment when I was at the mine in January.

The ore is of good quality, about 60% in iron and not far above the Besse-

mer limit. The bottom of the shaft is 30 feet north of the ore. The company works 100 men. The ore is used in the Deer Lake and Vulcan furnaces largely.

Annual product of the Detroit mine:

Year.	Tons.	Year.	Tons.
1882.....	5,402	1885.....	19,755
1883.....	12,314	1886.....	39,066
1884.....	3,098		
Total.....			79,635

April 16, 1887, a stream of water was tapped by a blast which resulted in such an inward blow as to fill the mine with water far beyond the capacity of the pumps to remove. Additional pumping machinery has been procured and at the present writing every effort is making to lessen the flood of water. Probably it will not be before the middle of May to 1st of June that the mine will be in its normal condition.

Jas. McMillan, Secretary and Treasurer, Detroit, Mich.; W. J. Officer, Superintendent, Ishpeming, Mich.

East of the Detroit is the Cleveland hematite, and the land on the west is owned by the L. S. Iron Co., that is now engaged in preparing to sink a shaft with the view to mining ore.

Capt. Officer has charge of an exploration in Sec. 34, directly north of the Detroit mine, that is looking well. He has a shaft sunk 150 feet south of the west end of Teal Lake which is in ore. The dip is away from the lake.

Also they are working on E. $\frac{1}{2}$ of lot 5, and on lots 6 and 7 east of the Cambria. It is called the BEN NEELY exploration. They have been at it for a year or more and have now good prospects of a mine. The ore found is of good quality, similar to that of the Cambria mine, and I judge they are pretty sure to open a good body of it.

Exploration also is carried on east of Teal lake, with varying success. No assurance of a mine yet.

THE MICHIGAMME COMPANY.

The Michigamme mine is again actively working. The late depression in the iron business led to a temporary suspension of work in the mine.

The Michigamme is the most westerly hard ore mine that is operated in the Marquette range, or, for that matter, in the State. The mine has never come up to the expectations that were entertained regarding it at the time it was

first opened. The deposits of ore have proved to be of too limited extent—too short and too narrow, and in some of the stopes and pits the ore is not clean enough, *i. e.*, not fully free from rock. It, in such cases, requires a good deal of sorting, picking over, which adds to the cost. The ore is, in No. 4 shaft, a medium grained magnetic of superior quality, being very clean, high in iron and low in phosphorus. But in some of the other shafts, No. 5 and No. 3, the ore contains a mixture of actinolite, hornblende, which renders it objectionable to furnacemen.

Mining operations were begun here in 1872, when it was determined to change the location of the main line of the railroad from the south side of the lake to the north. The discovery of ore had been made, and exploring work begun in Sections 19 and 20, T. 48, R. 30, near the northwest extremity of Michigamme lake. No mine in the district, in its early history, made more extensive or substantial arrangements with view to meet the requirements of a large and permanent mining business, than did this company at the start. The shaft houses were heavy framed and well covered. The large building for holding the machinery was made of stone with iron roof, and is even now one of the best in the region. The hoisting plant, etc., was, at the time it was placed, among the most powerful to be found in the district. Perhaps the outlay and preparation were greater than the requirements of the mine, as shown by subsequent development, proved necessary. But experience shows that it is impossible for any one to determine in advance how well a mine will develop. He knows better after it has been worked a few years, but he can only conjecture beforehand. Of course, a judgment becomes more valuable in such circumstances the better qualified a person is who forms it.

The formation at the Michigamme trends very closely east and west, and the dip is south, towards the lake, at an average angle of about 60%. The rock overlaying the ore is massive gray quartzite, and the foot wall a magnetic, ferruginous schist. A little way north of the mine is the greenstone range, which in places rises to a considerable height. South of the mine, in the low ground, are indications of the occurrence of black slate and actinolite schist. The mine is a long one—that is from No. 1, the east shaft, to No. 7, the extreme west one, the distance is upwards of half a mile, but at present they are only working in Nos. 4 and 5. The former has always been the mainstay of the mine, giving the best ore and the most of it. The length of the deposit in this shaft has averaged about 400 feet, terminating with a heading of rock at each extremity. The shaft is a very crooked one, occasioned by the fact that in sinking it they have kept in the ore, and rested mainly on the foot wall. The foot wall does not dip with any regularity. It is sometimes steep and sometimes very flat, so that, in conforming to it, the shaft changes its in-

clination at each level; and again, the ore occasionally sets off into the hanging, and in order to reach it with the skip road, the hanging wall has to be cut out at the shaft, commencing from above where the jump in the ore occurs.

Such a condition now exists in the bottom of No. 4, 600 feet down from the surface on the lay of the shaft. The ore had become very narrow—about four feet in width. Recently they cut south into the hanging wall at a point 160 feet west from the shaft and have the ore 35 feet wide horizontally, probably 20 feet wide, at right angles to the walls. The ore is the best. They are sinking in it at this point and will drift east to the shaft. At the present writing—January—this is the most promising thing in the Michigamme mine. They are now hoisting the ore from the winze and trammig it to the shaft. The hanging will be cut out for the skip road to reach this body of ore.

No. 5 pit may be entered by going north from the west end of No. 4, through either of two cross-cuts 120 feet in length, the lower one being 324 feet below the surface, or he may descend from the surface through the new No. 5 shaft, 450 feet down to the bottom. This shaft is a good one, being straight and well equipped. They are now stoping in two levels, the bottom and the one next above it. The ore is about 10 feet wide but is scarcely, as a whole, first-class. In the lower cross-cut level the length of the mine is 550 feet, 400 feet west of the shaft and 150 feet east of it. Capt Cundy has a unique way of running up the buckets in the stope from below, in this level. His apparatus consists of a wire rope suspended from the roof near the shaft, the other end attached to the hanging in the level 125 feet below, at the stope, drawn taut; a shieve runs on this rope. To this shieve is attached a rope, which passes around a single movable pully and to this latter a hook for holding the bucket. The other end of the rope is attached to the winding drum above. When the bucket is filled the signal is given and it is speedily drawn up and its contents dumped into the car, when it as quickly descends to the stope. It is easily set up and operated and involves little expense.

In the bottom level they have worked 100 feet east of the shaft and 350 feet west of it. The mine lengthens west. At 300 feet the ore is apparently faulted to the north and goes on west at its full width. The breast is 50 feet west of this fault and within about 150 feet of old No. 6 pit into which they expect to open. They are hoisting about 160 tons daily through the winter, working about 150 men—100 miners and 50 surface men, etc.

Mr. J. C. Fowle still remains superintendent, while Capt. J. P. Christopher, so long the mining captain, severed his connection with the company to accept the superintendency of the Ironton mine, near Bessemer, Mich. He was succeeded by James Cundy, a well known miner, who has a long and successful

experience in the region. Still more recently Capt. Cundy has gone to the Champion mine and the position he held at the Michigamme has been filled by the appointment of George Orr, for a long time an employé of the company.

The annual products have been as follows:

Year.	Tons.	Year.	Tons.
1872.....	141	1880.....	52,944
1873.....	28,986	1881.....	57,115
1874.....	45,772	1882.....	43,712
1875.....	44,752	1883.....	42,533
1876.....	20,974	1884.....	28,757
1877.....	26,228	1885.....	12,372
1878.....	58,622	1886.....	42,895
1879.....	56,565		
Total.....			615,888

The estate covers 1,400 acres of land.

There have been an unusual number of fatal accidents at the Michigamme mine the past year; heretofore for several years there was but one man killed, but during the past year there have been three. And yet, after hearing all the facts, I cannot say as any blame is to be attached to the company. One of the cases was that of a boy working in No. 5 pit. He started to go down the ladder after supper to his work, and somehow fell away to the bottom; as no one was with him it is not known how. I have been up and down the same ladders and regard them as safe as such passage ways usually are. The other two men lost their lives in the mine. One by reason of a piece of rock falling out of the wall of the vein above him and striking him, and the other lost his life by the overturning of a tram car loaded with rock. I think a wheel came off just as the car was passing along by a winze where some men were working in the level below. The car overturned and the load went down the winze, striking one of the men and killing him.

THE SPURR MINE.

No mining work has been done at the Spurr the past year. The mine closed down three years ago and has since remained idle. It was contemporaneously opened with the Michigamme, and was then a very promising mine. It is a pleasant location, and the company has all the plant and buildings necessary for operating a large mine. It is a good property to explore. The company owns in fee simple the N. $\frac{1}{2}$ S. W. $\frac{1}{4}$ and S. $\frac{1}{2}$ N. W. $\frac{1}{4}$ S. 24, 48, 30, being two-

miles west of the Michigamme. The mine has produced a total of 164,941 tons.

H. P. Pulling, President, 32 Congress street, Detroit, Mich.

THE NORTH RANGE MINES

have, with a few exceptions, all been idle for two or three years past. Now again there is evidence of a renewal of activity, and during the coming year nearly all will be working. The most easterly of the mines in this range is

THE ST. LAWRENCE,

which is situated about three miles from Ishpeming, in the N. W. $\frac{1}{4}$ of Sec. 5, T. 47, R. 27. The mine has not been worked since 1883, at which time I visited it. They were mining very cheaply in the shallow contiguous pits, running east and west and dipping south, the east one about 80 feet deep. The ore has a good width but did not appear to be very clean; it was somewhat mixed with rock. At best it seems a low grade ore, 53 to 57% in iron and .086 to .104% in phosphorus. A track extends to the mine from the main line of the C. & N. W. R. R.

Mr. John R. Wood, the former superintendent of the mine, recently bought a three-fourths interest in the lease of the mine for, it is said, a very moderate sum, and, as he previously held one-fourth interest, this purchase made him sole owner. It is also reported that he has sold a controlling share of the stock for \$51,000, and will himself assume the charge of the work at the mine. Some new machinery has already been received, and it is probable that work will be pushed at this mine to its utmost the coming year. The total output has been 21,963 tons.

A new organization has been made, changing the name of the mine to Nonpareil.

Sheppard Homens, New York, President; J. R. Wood, Appleton, Wis., V. P., Sec. and General Manager.

THE DEXTER MINE

will also be worked, and preparations are making to that effect. The ore is a medium brown hematite, of fair quality. Still further west, about two miles, is the

STERLING MINE

which, it is stated, will be worked again the coming year, after lying idle since 1883. The Sterling has the finest of ore, Bessemer hard ore. The property

is the W. $\frac{1}{2}$ S. W. $\frac{1}{4}$, Sec. 32, T. 48, R. 28. The mine is a small one, and has a very meagre equipment. A single shaft close to the east line of the property is the only avenue to the underground workings. Further west some diamond drill borings disclosed the probable existence of ore in larger body further west on the property where the land is extremely wet. But all this was fully described in the report of 1882, written in summer of 1883. The mine has produced in the four years it was worked an aggregate of 15,642 tons of ore. At the present writing it is not known if

THE BOSTON MINE

will be worked. No ore from the lake can be sold for a greater price than can this. It is the best of hard specular ore, as was fully explained in the last report. The mine is well equipped. The plant of machinery is excellent, and includes a new Norwalk compressor, power drills, diamond drill machine, etc. There are on the location a suitable number of good dwelling houses, and other necessary buildings. While it is possible that the Boston may not become a large mine, there is certainly ore enough in the portion of the deposit that has been opened to insure a fair product, and it should be mined at a good profit. The first class Boston ore would sell the coming year at \$7.00 per ton in Cleveland, or at about \$5.00 at the mine.

The ore averages about 68% in metallic iron, and $1\frac{1}{4}\%$ in silica, and .018% phosphorus.

No ore has been raised at the mine since 1883. The aggregate product for the four years in which mining was done was 61,715 tons. The Boston Mine Company owns the fee of the land—80 acres S. E. $\frac{1}{4}$ S. W. $\frac{1}{4}$, and the S. W. $\frac{1}{4}$ of the S. E. $\frac{1}{4}$ of Sec. 32, T. 48, R. 28 W., being about two miles north of Clarksburg, a station on the M. H. & O. R. R.

Samuel Mather, President, Cleveland, Ohio; James Pickards, Secretary, Cleveland, Ohio.

Further west in this range the

PASCOE IRON CO.

continues to work each summer, raising and shipping a moderate amount of ore. The mine is north from Champion about a mile, being in the S. $\frac{1}{2}$ N. E. $\frac{1}{4}$ Sec. 29, T. 48, R. 29. The strike of the formation is east and west and the dip to the north. The situation is favorable for economical mining. If ore of this quality were in sharp demand so that it could be mined at a fair profit the work could be pushed to the extent to secure a larger product. It is a medium grade hematite, with certain qualities exactly the reverse of what is desired,

that is, it is high in phosphorus and low in iron, about .30% in the former and 55% to 58% in the latter. It is also low in silica.

The following table gives the yearly output:

Year.	Tons.	Year.	Tons.
1882.....	18,880	1886.....	18,244
1883.....	-----	1886.....	10,072
1884.....	11,465		
Total.....			58,667

D. H. Merritt, President, Marquette, Mich.

Directly north of the Pascoe is

THE MATT. GIBSON MINE,

operated by Matt. Gibson and Joe. Mitchell, who hold a lease of the property, the N. $\frac{1}{2}$ S. E. $\frac{1}{4}$ Sec. 29, T. 48, R. 29 W. The ore is identical with that of the Pascoe and the other mines of this locality. It is worked in open pit, and 12,142 tons of ore were mined in 1886 and 1,515 tons in 1885, making a total of 13,657 tons. It is reported that the mine has been sold to Samuel Mitchell for \$50,000.

Matt. Gibson, Manager, etc., Republic, Mich.

Directly west of the Gibson is the

DALLIBA MINE.

The property comprises the S. $\frac{1}{2}$ N. W. $\frac{1}{4}$ and the N. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$ of Sec. 29, T. 48, R. 29 W. That no ore has been raised in this mine since 1883 is not due to exhaustion of the mine, but to the condition of the iron market for the past few years, to the quality of the ore, and to the embarrassed financial condition of the affairs of the company. The ore is identical with that of the other mines working in this range in the vicinity of Michigamme Lake; almost the only objection to it being the high percentage of phosphorus which it contains, $\frac{1}{4}$ to $\frac{1}{2}$ of one per cent. The mine is provided with the requisite machinery for prosecuting mining work. The company has been under a load of debt for some years, which has resulted in the change of ownership of the property and the organization of a new company, which latter has assumed the name of the PHENIX IRON MINING CO., with Peter White, of Marquette, as Secretary, Treasurer and General Manager. The resumption of work at the mine was begun about the middle of April last, and at the time of my recent visit the mine was nearly free of water.

The superintendency is, temporarily, in charge of Mr. Ed. Joplin, of Marquette. It is expected that 20,000 tons and upwards of ore will be mined the coming season. The mine was operated from 1881 to 1883—for three years—during which time the following products were raised :

Year.	Tons.	Year.	Tons.
1881.....	10,986	1884.....	
1882.....	44,836	1885.....	
1883.....	1,687	1886.....	
Total.....			57,509.

On the neighboring properties which have been heretofore described as the MESNARD, NORTHAMPTON AND MARINE, no mining work has been done since 1882.

West from Lake Michigamme are several mines, which afford ores identical with the ore found in the mines just described. The most easterly of these mines is

THE WETMORE,

situated in the N. W. $\frac{1}{4}$ of Sec. 25, T. 48 N., R. 31 W., owned by the Michigan Land & Iron Co., and held on a lease by Mr. Ed. Wetmore, of Marquette, who has continued to mine a moderate amount of ore each year since 1882. Previously to commencing mining work Mr. Wetmore thoroughly explored the property by means of test pits and the result was such as to indicate the existence of ore in unusual quantity.

There is a brook with a rapid current that runs southerly along near the west boundary of the property, and then cuts across southeasterly, the southwest corner of the land. The general slope of the surface for some distance to the east is in the direction of the creek. The test pit work is a succession of pits mainly along the east and west center line, and dug in lines north and south. The foot wall, proper, found about 80 rods north of the center line, is an actinolite schist and dips to the south at a variable angle of 30° to 50°. The hanging wall is a micaceous quartzite. Mr. Wetmore states that he found this quartzite in three or four of the pits. Pieces of the actinolite schist and of the plumbagenous slate which underlies it are to be seen in the drift overlying the formation. The strike is east and west. Not far east of the center of the west boundary and 12 feet above the creek is No. 1 pit, and east of it, about 150 feet, are Nos. 2, 3 and 4 pits. These I saw in 1882 and in 1883 soon after they were sunk, and from the facts obtained, by observation and from Mr. Wetmore, the following results may be chronicled. No. 1 was a shallow pit owing to the water, but loose ore was found, the others mentioned were dug

north and south across the formation. No. 2 was 20 feet deep and good limonite ore was found in the bottom. No 3 pit is 30 feet south of the former and probably did not reach the ledge, though ore is found in the debris surrounding the pit. No. 4 is about 35 feet south of No. 2, and shows good hard limonite ore. It is probable that the ore extends all the distance between Nos. 2 and 4 pits, the extreme ones, and perhaps to a much greater thickness.

From these pits it is about 250 feet east to the west end of the open cut which leads to the stope from which all the ore has been mined. The bottom of this cut is on a level with the ore dock along the R. R. track, and about 25 feet above the creek. The cut is about 350 feet long east and west, the breast of ore becoming higher as the work progresses eastward, being now 25 feet high. It is not possible with the present knowledge to give with certainty the width of the ore. In the pit neither the foot nor hanging wall has been reached, but the ore, measured at right angles to the strike, is 55 feet wide. About 270 feet easterly and a little south of the open cut is another series of test pits. In No. 6, the most northerly one, there is nothing in the refuse to indicate that the ledge was reached. The contents removed show nothing but gravel. It is but 12 feet deep. No. 7 is 50 feet south of the former, and was dug 21 feet deep, having for the bottom hard limonite ore. The other two pits of this series, Nos. 8 and 9, reached what was supposed to be the hanging wall of the ore, being quartzite. This is probably near the east end of the lense of ore of the open pit, or possibly the west end of a lense of ore to the east. About 80 feet easterly from No. 8 pit is No. 10, in which hard limonite ore was found at a depth of ten feet. Still further east 180 feet is another series of test pits, of which the most southerly one has a depth of 40 feet. In this, after passing through the drift and succeeding rock, clean ore was reached. In the bottom a drift was made to the north 35 feet in length, all of it cut in clean limonite ore. From this pit, No. 11, to 19, all were ended in ore. These extend across the formation a distance of 215 feet. Apparently they indicate a width of ore equal to at least the distance between the two extreme pits.

No 12, 15 feet deep, afforded yellow ore. No. 13, 15 feet deep, yellow and red ores. No. 14, 15 feet deep, hard yellow ore. No. 15, 10 feet deep, hard brown ore. No. 16, 10 feet deep, yellow ore. No. 17, 12 feet deep, brown and red ores. No. 18, 10 feet deep, the brown and red ores. No. 19, 10 feet deep, brown and yellow ores. No. 20, 10 feet deep, mixed ore and rock, supposed to be in the foot wall.

Mr. Chas. E. Wright collected from each of these pits samples of the ore in order to obtain an average of the shipping ore across the formation. These samples, after being crushed and ground in the mortar and the powder thoroughly mixed, gave by analysis:

Metallic iron.....	59.49%
Phosphorus.....	.139%
Silica.....	5.52%

Considering how the samples were taken, the above is certainly a very good result.

No. 21 pit is 160 feet east of No. 11, and shows hard brown ore; and Nos. 22 to 25 inclusive, extending in a line north and south, were not sunk deep enough to reach the ledge. In the last one mentioned was found a boulder of magnetic ore weighing, by estimate, not less than 20 tons. Again, easterly about 200 feet, are pits 25 and 27, neither of which reached the ledge.

South 64° east from No. 11, and 600 feet distant, are pits Nos. 28 and 29, in both of which good brown ore was found, also siderite, or carbonate of iron in 29. This brings the explorations to within 450 feet of the east line of the property, or about 2,000 feet east from No. 1 pit.

It is not necessary to assume that there is a continuous run of ore for the entire distance. As fair an inference would be to expect the occurrence of several lenses that may lap, the one upon the other, but are separated by intervening rock. Furthermore, in going eastward, should the end of a lense be reached, the next one will be found to the right.

The ground lies favorably for cheap mining, and it is safe to estimate a product of 300,000 tons above water drainage.

The ore, with the present price of labor, can be mined for 60 cents per ton, provided that 20,000 tons or more are taken out annually. The ore requires little or no sorting, it is practically clean ore, holding among its impurities a considerable percentage of lime, that should render it easy to smelt.

Mr. Wetmore is preparing to operate the mine with machinery; a hoisting plant consisting of two boilers, engine and two winding drums, with space for two more when required, will soon be completed at the mine.

A track from the main line of the M. H. & O. R. R. comes in on the foot wall side of the ore. The grade is 4 feet in 100, and on an 8° curve, not a favorable track, but the grade is down from the mine.

The following table shows the annual product:

Year.	Tons.	Year.	Tons.
1882.....	1,706	1885.....	5,887
1883.....	2,766	1886.....	10,756
1884.....	4,585		
Total.....			25,771

Ed. A. Wetmore, Manager, etc., Marquette, Mich.

THE WEBSTER MINE

adjoins the Wetmore on the west. The Webster lies west of the brook which runs between the two mines. The Webster has been idle for several years, until recently, owing to the condition of the ore market, and the embarrassed condition of the company's financial affairs.

The mine is now controlled by Messrs. Watson and Palmer, of Marquette, and the ore is mined on contract by Mr. Fred Dishno, at 80 cents per ton. This sum covers all the mining expense for the ore, delivered in the cars. The mining is all open cut work. There are two pits; the main one is about 60 feet deep and 200 feet long and the other of slightly lesser dimensions.

The ore body is fully 100 feet in width, and the ore is of the same quality as the Wetmore, about 60% in iron and .25% in phosphorus; 9,260 tons were mined during the year 1886, and there are now about 12,000 tons in stock, which occupies all the dock room, so that work has been suspended until after the opening of navigation. It is expected the season's product will be about 40,000 tons.

The force employed is about 40 men. The ore is not entirely clean; it has to be picked.

Year.	Tons.	Year.	Tons.
1882.....	4,413	1885.....	---
1883.....	---	1886.....	9,246
1884.....	930		
Total.....			5,589

Watson and Palmer, Managers, etc., Marquette, Mich.

In 1881 and in the summer of 1882 some exploring work was done at several points west of the Webster, at each of which a good showing of ore was made, but no work has been subsequently done at these points, except at the well known mines, the Beaufort and the Titan.

Between the Webster and the Beaufort, in the same section, to-wit: the S. E. $\frac{1}{4}$ of the S. E. $\frac{1}{4}$ of Sec. 22, T. 48, R. 31, is an exploration designated as

THE PORTLAND,

where a line of test pits dug across the formation indicated the existence of a body of ore 80 feet in width. But then the extent of the ore can only be a matter of conjecture with the limited data. It is only probable that there is ore enough for a mine of greater or less dimensions. Some controversy regard-

ing the lease of the land, together with the depressed state of the ore market, have prevented further work until now it is proposed to open a mine, and a few men are already at work on the location—April 15, 1887. Mr. J. C. Fowle, Superintendent of the Michigamme Co., has charge of the work. The same gentleman is also superintending the opening work on the adjoining property in section 26, to-wit: the N. $\frac{1}{2}$ of the N. W. $\frac{1}{4}$, T. 48, R. 31. The explorations made here in 1881 and '82 gave equally favorable results as were obtained in section 22. It is also proposed to mine and ship ore from this land the coming season.

THE BEAUFORT IRON MINING COMPANY.

The Beaufort mine, in the N. $\frac{1}{2}$ N. W. $\frac{1}{4}$ of Sec. 22, T. 48, R. 31, continues to look first rate. I visited the mine in April last, and found all the indications, etc., very favorable.

The mine is now wholly under ground, and has a length of about 600 feet east and west. The ore is continuous, and averages, at right angles to the wall, 20 feet in width. The dip is to the south, lying very flat, the angle being about 28° with the horizon.

The mine is dry, the ore hard brown and yellow hematite, that stands well in the pillars and stopes, as does also the hanging wall, so that the ore can be mined out in large rooms, leaving pillars of ore between. These rooms are from 15 to 30 feet wide, and the pillars are about 20 feet. The ore is easy to mine, as it breaks out in large blocks, and is reasonably clean. The company work about thirty men, and has about 5,000 tons of ore in stock. If the mining work were pushed a large product could be got out. There has been for a few years past so little demand for this quality of ore that but a small product has been mined. There are two shafts. No. 1 goes down in the east end of the open pit, and is 160 feet in length. No. 2 is sinking vertically from the surface, about 300 feet east from No. 1, and is about 60 feet deep, 30 feet through sand and gravel, and is 30 feet in ore. The shafts are connected by drift through the ore. The machinery consists of two boilers, two drums—Akron, Ohio, make— $4\frac{1}{2}$ feet diameter, and Burleigh compressor.

Hon. S. S. Curry, President, Ishpeming, Michigan; M. E. Williams, Superintendent, Beaufort, Michigan.

THE TITAN IRON MINING COMPANY'S

mine joins the Beaufort on the west. The mines are only separated by a bar of ground. In essential features the two are nearly identical. The Beaufort, however, seems to have a greater length of ore than has been developed in the Titan, and possibly the ore in the latter is more mixed with rock, and requires

more picking. The mine is also wholly underground, and about 500 feet of length of opening. The west end of the mine is poor, the rock cuts out the ore. The company works about 30 men, and there are two shafts, two hoisting drums, compressor, Camp, Lane & Webster, each $4\frac{1}{2}$ feet in diameter, and in the last year there has been added an Ingersoll compressor, having the capacity of operating seven drills. There are three only used in the mine. Like the Beaufort the Titan could furnish a larger product. The ore deposit is fully 20 feet wide, and the roof and pillars stand well. There is about the same amount of ore in stock as there is at the Beaufort, and the mine is controlled by the same officers, M. E. Williams, Superintendent; S. S. Curry, President, etc.

THE CHAMPION IRON CO.

is undoubtedly one of the best conducted mining corporations in the State. The management has always been liberal with its employés and progressive in its methods of work.

The mine is noted far and wide for the uniform excellence of its ore and for the magnitude of the product. The ore is the best specular slate and magnetic; there is none better found in the State. It commands the highest price and is the most eagerly sought for by the furnace men for the manufacture of Bessemer pig. Two-thirds of the product is first-class ore, that averages about 68% in metallic iron, .040% phosphorus and 1.50% in silica. All the ore taken from the mine is Bessemer; the grading is made on the percentage of iron contained.

The Champion mine location is one of the pleasantest and healthiest in the iron region, situated upon the level plateau overlooking the valley and hills to the north and the waters of the beautiful Lake Michigamme to the west. The buildings, miners' houses, etc., are substantial, commodious and neat, every house has a garden, for which the soil is well adapted. Besides the dwellings, there are other provisions made for the comfort and well being of the men and families not usually found at mines, at least not usually of such excellence and furnished at the expense of the company as they are here. Among these are bath rooms connected with the change house; there are 14 of these rooms, all provided with good zinc lined bath tubs with hot and cold water, which is pumped from Michigamme Lake, and hence pure and sweet. The change house proper is also supplied with every requisite for convenience and comfort. A large fine building has been erected by the company, centrally and pleasantly located, containing a commodious hall suitable for public meetings, entertainments, etc., also having apartments for library and reading room.

The latter is furnished with leading daily and weekly papers, magazines, etc.,

and is open day and evening, kept warmed and lighted, and is accessible and free to all.

There is a large, handsome school building erected a few years ago, in which a well-regulated graded school is maintained. Several fine church edifices adorn the location, affording the conveniences for varied religious worship. Good sidewalks, streets, shade trees, etc., prevail, and a pleasant grove of maples situated in the village has been preserved and rendered clean and pleasant for the use of the people. On public holidays, such as the 4th of July, in the summer, it has been the custom of the company to furnish a band of music, and the use of its steamer and boats, for free excursions on the lake. Every pains has been taken at such times to make the occasions happy and enjoyable.

In the matter of wages, the Champion has always been esteemed among the most fair and liberal. It pays as good prices for its work as any of our companies. At my recent visit to the mine, April 10, I saw the labor cash sheet for the preceding month of March. No class of miners were having less than \$2.25 per day.

The average daily earnings for drill men were.....	\$2 57
The average daily earnings for miners, sinking and drifting.....	3 11
The average daily earnings for trammers.....	2 19
The average of all miners underground daily wages.....	2 70
The average of all miners on contract, daily wages.....	2 52

The mine is a good one to work in; as safe as any and dry and with good air. Two fatal accidents occurred in 1886; one man and one boy were killed. The former, a new man, fell into a shaft. The force employed averages 500 men. I have been particular in referring to the above matters owing to the strike by the men a few weeks ago, the only one that has occurred at any of our mines, recently. I wished to ascertain how just cause for complaint the men might have against the company. By all I could learn, in talking with the men, and with officers of the company, the trouble was caused largely by agitation and misrepresentation emanating from irresponsible persons who had for good cause been discharged from the company's employ.

In repairs and improvements on miners' houses, the company has expended in the past year \$13,000. Among the important improvements made in 1886 is in the method of hauling the wood from the lake up to the mine. The wood for the boilers and the use of the location is obtained from lands surrounding Michigamme lake, and is taken to the lake from the woods in cars, on tracks laid for the purpose. The cars hold two cords of wood each, and run onto the flat boats, which are towed to the landing by a steam tug owned by the com-

pany, whence they are hauled up the incline 4,800 feet long, 180 feet rise, by stationary engine and wire rope. The arrangements are admirable for expeditious working. They can remove from the scows, so stated, 24 cars in 15 minutes' time. This number can be hauled up the incline to the boiler house. The cars are provided with a simple automatic brake, consisting of a shoe and chain that stops the car immediately if anything gives way. The machinery for operating this track consists of an engine 18"x24"—drum 8' diameter, 8½ feet face. Here, as elsewhere in the mine, the electric bell is used to signal.

One of the most promising things at the Champion is a 'new find,' just east of the East Champion mine. Here they have removed the dirt and exposed the top of a lense of ore 26 feet wide and 75 feet east and west. The lense pitches to the west and dips to the north at a sharp angle. The ore is slate and magnetic, of seemingly good quality. It is expected that this will add greatly to the product the coming year.

In the mine the lenses of ore are somewhat contracted in dimensions in the bottom as compared to the magnitude which they hold in the upper levels. Formerly the Champion mine had a few immense stopes that furnished the product; now there are more stopes than heretofore, none of them so large, but generally looking fairly well, and in the aggregate suffice to keep up the product.

The general features of the mine at the present time may be sketched as follows: No. 1 shaft, the most easterly one, is not worked. No. 2 is down to the fifth level in the north deposit; below that point the ore, owing to the westerly pitch, went to No. 3 shaft. South of No. 2, in the south deposit, is an old shaft, designated as B, in which they are now working at a depth of 125 feet. The ore is west of the shaft 100 feet, and 15 feet wide, good, second class magnetic. Work in this ten men and one drill. They stope out as fast as they sink, *i. e.*, sink a level and stope the ore, and by the time it is exhausted have another ready to begin on.

No. 3, above the eleventh level, had both the north and the south deposits; at the eleventh they come together, but further down in the twelfth, thirteenth and fourteenth levels they have the two deposits again, somewhat less regular, however, and smaller than they were above.

The levels have uniformly shortened on the east, now they are lengthening in that direction. This has occurred in the eleventh, twelfth and thirteenth. The latter is 100 feet east of the shaft, and the ore is 10 feet wide and continues to become wider. West of the shaft in the twelfth, thirteenth and fourteenth levels all the ore is standing, 30 feet wide. From the surface to the fourteenth level is 840 feet.

No. 5 shaft has encouraging features. In the eighth level the ore extended

156 feet west; in the ninth level the length west reached 171 feet, and in the tenth they are already 50 feet west of the line, which should limit the ore if a uniformity in the cut-off occurred, and still they find no rock to bar their progress. The ore is the best of slate and black ore side by side. They are also working west in No. 5 in the third level and have a stope of ore.

No. 6 shaft is 160 feet deep and at the bottom they have drifted east towards No. 5, 125 feet. West of No. 5 the ground is all unexplored; it is possible that other lenses of ore will be found between Nos. 5 and 6 shafts. It is also the supposition, based on the experience with the other shafts, that as the ore pitches west, No. 6 will cut the main ore lenses when the proper depth is attained.

No. 7 is 300 feet deep. They are sinking and stoping. The ore body gives a stoping length of 100 feet, with a width of eight to ten feet. The shaft is in rock. They drift to the ore.

The Champion will probably furnish an output the coming season of 160,000 tons, worth in the lake ports \$7.50 per ton. It is probable that the product of the Champion may not again equal its out-put of 1884, but it may be relied on for a large annual product still.

Products of Champion mine in previous years:

Year.	Tons.	Year.	Tons.
1868.....	6,225	1878.....	73,764
1869.....	21,535	1879.....	93,203
1870.....	73,161	1880.....	112,410
1871.....	67,588	1881.....	144,025
1872.....	68,402	1882.....	157,516
1873.....	72,782	1883.....	104,960
1874.....	47,097	1884.....	208,156
1875.....	56,877	1885.....	173,914
1876.....	66,002	1886.....	137,593
1877.....	70,883		
Total.....			1,755,835

The officers are W. E. Stone, Treasurer, Boston, Mass.; A. Kidder, Agent, Marquette, Mich.; W. Fitch, Superintendent, Champion, Mich.; James Cundy, Mining Captain; Wm. Williams, Master Mechanic.

THE HUMBOLDT IRON CO.

There is nothing new or encouraging to record of the Humboldt mine. I

have fully described it in previous reports, and find nothing of interest to add. The mine has been gradually assuming each year smaller dimensions.

Mr. Maas, the agent, is exploring with the diamond drill in ground to the east where there is reason to expect success. The formation presents many features of an encouraging character. The ore is hard specular, of good quality, but non-Bessemer, which sold in 1886 at an average price of \$5.33 per ton.

J. B. Maas, Agent; Ed. Maas, Superintendent, Humboldt, Mich.

The Humboldt mine, including its predecessor, the Old Washington, has produced annually as follows:

Year.	Tons.	Year.	Tons.
1865.....	4,782	1876.....	3,333
1866.....	15,150	1877.....	16,546
1867.....	25,440	1878.....	23,921
1868.....	37,757	1879.....	18,204
1869.....	58,462	1880.....	14,727
1870.....	79,712	1881.....	26,302
1871.....	48,725	1882.....	43,436
1872.....	38,841	1883.....	31,866
1873.....	38,014	1884.....	23,763
1874.....	27,890	1885.....	11,776
1875.....	9,642	1886.....	20,207
Total.....			626,545

THE REPUBLIC IRON CO.

In going through the Republic mine recently with Mr. Morgan, the President, and Capt. Pascoe, the former remarked that they had not yet devised how to mine out a large quantity of ore without leaving openings in the ground of corresponding magnitude, and in time making it apparent that the constant drift upon the resources of the mine has served to materially lessen the amount of ore originally held in store.

The Republic has still a great deal of ore in sight, and is certain to be a large producing mine for some years to come, but it is not likely that the annual product hereafter will equal what it has been in preceding years unless the pillars are resorted to. There is more first-class hard ore to be seen in the Republic mine still, than in any other mine in the State, but the stopes are less than formerly. There will be, probably, a considerable falling off in the product of the pits at the southwest part of the mine, particularly in the Pascoe pit, which will not yield to exceed half of the product of 1886. The

shaft is 860 feet in length. The formation is very much contorted, the lateral pressure to which it was at some period subjected, having made innumerable sharp folds that have served to place the ore across instead of with the formation. These bodies of ore are exceedingly irregular. There is no instance of greater irregularity to be seen in any of our mines than appears in the Pascoe pit. The ore is mainly back of the shaft, east of it, in the jasper foot wall, and has been found in every direction and in every form of body. Just now, however, there is comparatively little ore to be seen in the bottom; a drift into the hanging wall has revealed a deposit of slate ore that may prove to be of suitable magnitude; it has not been developed yet—April 20, 1887. In the levels above are some good stopes. The Morgan pit—situated west of the Pascoe—is also poor in the bottom; it is the same depth and has similar characteristics. The ore is in narrow stopes across the formation and very irregular in form and in manner of occurrence. Further up in the pit, from the eleventh level up to the ninth, there is a good body of ore, which makes around the jasper that stands near the shaft, in the foot wall.

The Ely pit is also 860 feet in depth, and while it is equally as puzzling as the others, it shows far more ore than is to be seen in them. In fact the Ely will furnish about its usual product. These pits are down to the fourteenth level, and the Ely and Pascoe are connected in the eleventh level by a drift. The ore in the Ely is mainly specular slate, and averages 12 to 14 feet wide and 100 feet in length. It is all Bessemer. None of the pits in the Republic mine contain much water. The next, the fifth pit to the north, is the Gibson, and, at the time of my visit, it was not working. So far as they have been able to discover, there is little ore left. The pit will be worked again as soon as they have air enough for the machinery, the supply being short just at present.

No. 1 is the deepest pit in the mine, being about 900 feet deep. It seems to be looking first rate, *i. e.*, there is a good deal of ore in sight. A year ago the ore from this pit went up the crooked skip road described in the last report, to No. 5. This meandering skip road has now been done away with. All the ore that goes up No. 5 now, is taken from ore pillars. The ore in No. 1 lies behind the shaft in the foot wall. Though irregular in form there is enough of it to give a large product, and at a moderate cost. No. 5 large cage goes down to the eighth level, 500 feet from the surface. The cage is used for the men who are taken down on it to the eighth level, and use the ladders for the rest of the distance. The plan is, the present season, to mine away such of the ore pillars as can be spared in No. 5, and this will, in part at least, make up for the shortage to ensue in the Morgan and Pascoe pits. ^{xx}No. 6 double skip way, in the same shaft with No. 5, goes to the twelfth level, where they

have a run of 60 feet through jasper, where the ore comes in again. They have sunk an incline skip road, an underground shaft, down to mine this ore on the north. The ore is brought up from the bottom in the skip, dumped into a car, and is run to the main shaft.

In the bottom they are driving north in the ore to meet a similar drift going south. The ends are 45 feet apart now.

In No. 7 the run of ore is north and south. They have opened it 300 feet in length. The ore is fifty feet wide at south end and 20 feet at the north. Running with the magnetic, and underlying it, and in contact with it is a body of specular slate. No. 7 shaft is 760 feet deep. They open a drift along on the top of the ore, and at suitable distances winzes connect this drift with the level above. The pitch of the ore is northwest, and in a few years No. 8 will have the black ore, No. 6 both black and slate ore. The latter deposit is 60 to 70 feet long, and about 30 feet wide, while the black ore deposit overlaying it in No. 6 is very thick, and has a length of 300 feet. Together these two pits, 6 and 7, will give their usual product. No. 6 will give a little less than common, and No. 7 a little more. By taking out pillars in No. 5, the product of 1887 will probably about equal that of 1886. The mine is safe, but one man was killed in 1886, out of a force of 500 to 600 men. They are now—April—mining 60 tons a day from the pillars. The underground skip road goes from the twelfth to the thirteenth level, and they are sinking to the fourteenth. It is a substitute for the winding shaft formerly used.

The several pits at the Republic produced in 1886, as follows:

Pascoe.....	21,598 tons
Ely.....	21,952 “
Morgan.....	43,053 “
Gibson.....	5,969 “
Nos. 1, 5 and 6.....	73,827 “
No. 7.....	45,081 “
No. 8.....	19,146 “
No. 9.....	5,233 “
No. 1.....	94 “
<hr/>	
237,158 tons.	

Vessel rates from Marquette to Cleveland for 1887 will start at \$1.60. In 1886 the rates at start were \$1.25, and became \$2.10 at the end of the season. Republic Company ships most of its ore in its own vessels.

The officers remain as heretofore: David Morgan, President, Republic, Michigan; Peter Pascoe, Superintendent, Republic, Michigan; Geo. Wilson, Clerk.

The product for each year has been as follows:

Year.	Tons.	Year.	Tons.
1872.....	11,625	1880.....	235,385
1873.....	105,435	1871.....	233,651
1874.....	122,639	1882.....	235,108
1875.....	114,726	1883.....	152,565
1876.....	120,045	1884.....	277,739
1877.....	165,836	1885.....	249,070
1878.....	176,221	1886.....	241,161
1879.....	135,131		
Total.....			2,540,827

THE WEST REPUBLIC MINING CO.

The West Republic mine is in the west end of the ox bow shaped trend of the ore formation, which bends around the south end of Smith Bay, making the westerly continuation of the great Republic mine. The latter lies in the high jasper bluff that extends around the south and east sides of the bay, while the West Republic is situated to the west of the bay and extends under the Michigamme river to the west side of it.

Just now there is not much stoping ground in the mine—April, 1887—and the outlook for adding greatly to the product of 1887 is not bright. The ore in the drift across the river is in too small quantity to pay to mine and tram the long distance necessary to the shaft. The shaft—No. 2—is 450 feet deep, and they are preparing to abandon the use of it by sinking another 50 feet northeast of the former, down through the old workings and to give it the inclination necessary to reach the ore that is east of the river but pitches to the northwest. They are pushing ahead to find the hanging wall; the foot wall seems to go off very flat to the northwest. They expect to reach a stope of ore soon in this shaft.

They are also sinking a shaft about 250 feet southeast of the former, near the south line of the property—15 feet from it. The shaft is 50 feet deep and has some ore in the bottom. They discovered the ore on the Republic side of the line, and, as it dips northwest, it will of course be found on the West Republic property; whether it will prove of any commercial value remains to be seen.

Near the southeast corner of the land they have also sunk a shaft 125 feet and have a vein of pulverized slate ore mixed with sand. If it were not for this impurity it might be valuable. The deposit is about 15 feet wide and is apparently about 50% in iron and is probably Bessemer.

The company employs about 60 men.

J. O. St. Clair, Superintendent, Republic, Mich.

The mine has produced as follows:—

Year.	Tons.	Year.	Tons.
1881.....	7,378	1884.....	19,623
1882.....	27,865	1885.....	12,674
1883.....	30,734	1886.....	10,664
Total			109,348

Office 101 St. Clair street, Cleveland, Ohio; A. C. Saunders, Treasurer.

THE COLUMBIA MINE,

situated north of the Republic, has been idle during the past year and still remains so. The mine was opened in 1873 and worked until 1883, during which time 94,249 tons of ore were shipped.

THE FREMONT IRON CO.,

formerly the Erie, is also idle. No ore was shipped in 1886. The property and exploratory work were fully described in the last report, and there is nothing important to add.

THE PITTSBURG AND LAKE SUPERIOR IRON CO.'S

mine in the Cascade range has greatly improved of late, and in going through it a few days ago—April 20—I find it plain to observe the change for the better from what appeared a few years ago. Mr. Kirkpatrick's work with the diamond drill has had a good result, and has led to the discovery of bodies of ore through which the mine is enlarged and rendered more valuable.

The company has lately bought a controlling interest in a blast furnace at Sharon, Pa., to which place much of the ore is sent to be made into pig iron.

The ore is good quality—hard specular slate—non-Bessemer, but 64% to 66% in metallic iron.

In the old pits—Palmer mine—the ore has been followed until now the stopes are away off to the northeast at a considerable distance, horizontally, from the collar of the shaft.

The inconvenience resulting from this circumstance has led to the work of sinking a shaft which, when completed, will save the underground tramming. This shaft is vertical 6' x 16' in size and will be double cage. It is now 160

feet deep and will be in the ore at about 200 feet. The ore deposit in this pit is in two lenses separated by 20 feet of jasper; they are of good width and length and quite free of rock. Are hoisting here 60 tons per day.

At about 1,100 feet northeast of the mine the company is operating a shaft that was sunk a year ago. The shaft is 270 feet deep, is 6' x 10' in size. They use a bucket now but will furnish the shaft with skip. They are mining in this shaft 50 tons per day now. The ore is 14 feet wide and is opened for a length of 100 feet. Is clean, fine, hard specular.

The company expects to ship 60,000 tons in 1887. Contracts for shipping 48,000 tons have already been made at \$1.40 per ton from Escanaba to Cleveland. Railroad freight, 80c per ton.

Joseph Kirkpatrick, Agent, Palmer, Mich.

The company employs 130 men; none were killed in the past year.

Table of products:

Year.	Tons.	Year.	Tons.
1871.....	4,171	1879.....	24,141
1872.....	34,495	1880.....	38,595
1873.....	41,204	1881.....	34,273
1874.....	16,106	1882.....	40,590
1875.....	4,070	1883.....	19,414
1876.....	15,324	1884.....	11,747
1877.....	20,211	1885.....	5,679
1878.....	4,704	1886.....	24,034
Total.....			348,761

THE WHEAT MINE,

situated about a mile east of the Palmer, is also looking well, much better than heretofore. Some recent discoveries of ore have been made on the property that greatly enhance its value. The company ceased to work the hard ore mine several years ago and the ore shipped has been taken from the hematite deposit south of the hard ore on the opposite side of the railroad track. Here they have worked out a pit 200 feet long north and south and about 75 feet deep, with a skip road down at the north end. They are stripping off the sand west of the pit preparatory to stoping the ground in that direction. The ore is of good quality but is so mixed with rock as to require constant picking to render it merchantable ore.

On the north side of the track, at the foot of the hill that slopes to the south,

they have a new find of bluish hematite ore that is clean, and of better quality than that mined in the hill opposite to the south.

The company has been running a diamond drill northeast of the old hard ore mine and claims to have good results. The drill core indicates the finding of good ore. I understand that they bored through 32 feet of it. Altogether the outlook at the Wheat mine is much better than formerly.

The officers are Daniel McGarry, President; Thomas Prout, Superintendent, Palmer, Mich.

The mine has produced as follows:

Year.	Tons.	Year.	Tons.
1879.....	850	1883.....	6,625
1880.....	3,324	1884.....	6,824
1881.....	9,040	1885.....	9,200
1882.....	9,554	1886.....	15,851
Total.....			64,489

At the old

GRIBBEN MINE,

situated in the Cascade Range, in the S. E. $\frac{1}{4}$ of Sec. 28, T. 47, R. 26, Negaunee parties are now working—doing exploring work. At the time of my visit to the location they were operating a diamond drill, boring at a steep angle across the formation at the east end of the old open pit. The hole was then, about April 15, 225 feet in length. The drill was in hard ore of fair quality. The indications are good. Capt. J. F. Foley, of Negaunee, is directing operations.

West from the Gribben are a number of old mining locations, where work was done in 1872-3. One of these,

THE HOME,

also in section 28, has been recently explored. Mr. Ed. Anthony, *et al.* of Negaunee, had an option for a lease on the property, and did some exploring, which resulted, it is claimed, in finding ore 50% in iron, .020% phosphorus, and 30% silica. The parties who held the option disposed of it, and preparations have begun to work the mine the coming season.

The Cascade Range affords abundant indications of ore. Nowhere are they more plentiful. But those which appear in the outcrops are lean flag ores that have no market value—high in silica and low in iron.

The deposits of good, hard ore that have been worked have proved generally of limited extent, that gave no profit in working them. Still, until recently, the explorations have been wanting in thoroughness, as compared to such work in some other places. The rocks are well defined, and the ore formation is a broad one. It is quite possible that future exploring work in this range may result in discoveries of great value.

THE SWANZY AND CHESHIRE MINES,

situated in the N. E. $\frac{1}{4}$ of Sec. 18, T. 45 N., R. 25 W. The first ore was shipped from here in 1872, having been discovered by the veteran explorer, Silas C. Smith, after whom the mine was named. Subsequently it became known as the Cheshire. Afterwards Mr. J. J. Pierce, the owner of the mine, organized another company, the SWANZY, to operate an adjoining 40, the S. W. $\frac{1}{4}$ of the N. E. $\frac{1}{4}$, and the CHESHIRE was abandoned. Now again, work is to be resumed at the Cheshire and discontinued at the SWANZY. The mine is reached by a branch of the C. & N. W., and is near the bank of the Escanaba river. The ore is a soft hematite, similar to that found in the Norway mine, in the Menominee range. It averages about 60% in metallic iron, and .040% in phosphorus, and about 2.00% in silica, thus placing it within the Bessemer limit. However, it seems that the ore, so far as they have been able to determine, is about exhausted. Future exploration may result in finding other equally valuable deposits in this isolated locality.

The two mines have produced annually as follows:

Year.	Tons.	Year.	Tons.
1872.....	13,415	1880.....	13,201
1873.....	9,329	1881.....	15,011
1874.....		1882.....	31,494
1875.....	188	1883.....	13,730
1876.....	225	1884.....	3,557
1877.....	8,433	1885.....	
1878.....	16,924	1886.....	8,328
1879.....	17,831		
Total.....			152,100

J. J. Pierce, Sharpville, Pennsylvania, President, John R. Wood, Superintendent, Negaunee, Michigan.

THE FELCH MOUNTAIN MINING DISTRICT

will enjoy a moderate activity the coming year. The poor results obtained in

that section heretofore for all the exploring work done, induced its virtual abandonment so far as mining was concerned. There has nothing new been discovered; nothing to be said beyond what was mentioned in previous reports. The mines that will be worked are

THE METROPOLITAN,

the Northwestern and the Calumet. The former is situated in the N. E. $\frac{1}{4}$ Sec. 32, T. 42, R. 28 W., and the mine still contains a considerable quantity of medium grade ore. It is the property of the Metropolitan Iron & Land Co.

There has been shipped from the mine as follows:

Year.	Tons.	Year.	Tons.
1882.....	23,854	1885.....	
1883.....	36,643	1886.....	6,393
1884.....	27,527		
Total.....			94,467

S. S. Curry, President, Ishpeming, Mich.

THE NORTHWESTERN MINE,

which adjoins the Metropolitan on the west, also has considerable ore, possibly more than the Metropolitan, but it is medium grade non-Bessemer ore.

The mine shipped in—

Year.	Tons.	Year.	Tons.
1883.....	7,202	1884.....	10,004
Total.....			17,206

Wells Smith, Superintendent, Metropolitan, Mich.

THE CALUMET

is the only other mine in the Felch mountain range from which ore has been shipped. It is about three miles south from Metropolitan in the S. W. $\frac{1}{4}$ N. E. $\frac{1}{4}$ and S. E. $\frac{1}{4}$ N. W. $\frac{1}{4}$, Sec. 8, T. 41, R. 28. Here were opened in 1883 some deposits of excellent soft blue ore—running high in metallic iron and low in phosphorus—far within the Bessemer limit, but the deposits were shallow. They occurred in the limestone, which was the underlying rock, and were soon exhausted. The mine yet holds some lower grade ore, and it is said that some mining will be done here the coming season of 1887.

John R. Wood, Superintendent; A. B. Cornell, President, Youngstown, O.
Shipments have been as follows:

Year.	Tons.	Year.	Tons.
1882.....	5,847	1884.....	3,627
1883.....	29,239		
Total.....			39,113

THE GOGEBIC IRON RANGE.

Nothing in the previous history of Michigan mining has awakened so great a public interest as has been manifested in the Gogebic Iron Range in the past year. There has been, and still continues to be an immense amount of exploring done, and speculation has been rife. The entire range for a length of more than 30 miles, is dotted with so-called mines. Most of them are as yet mere explorations—mere beginnings—where they have either found no ore or have it in small quantity. It generally takes time, patience and money to find ore, and where there are no exposures, and the rocks are deeply buried beneath the drift, the work of development is slow, expensive, and uncertain. But zeal for investment in this range does not seem to be dependent upon any such tedious process.

There has been a veritable craze for mining stock. Innumerable companies have been formed, and the stocks were eagerly taken as rapidly as issued. Not unfrequently there is nothing apparent but the fact that the land is “on the range,” and is crossed by the ore formation, imagination does the rest. Apparently not a few are sufficiently endowed with this faculty to see in fancy, beneath the overlying surface, magnificent deposits of ore, of which the Colby is but the counterpart. At the present writing the excitement, which has prevailed for more than a year past, has culminated, and is tending to subside. Still, there is great activity in this region, in mining work, in exploration, in investment, in railroad building, in the growth of the towns, and in business generally. The mines are greatly hampered in their shipments of ore through lack of vessels, which if continued will lessen the season’s output materially.

The villages of Bessemer, Ironwood, Wakefield and others along the range are teeming with prosperity. Buildings are going up on all sides, and the towns are growing rapidly in size and population.

The Gogebic is proving to be one of the most valuable iron mining districts in the country. Perhaps no mineral discoveries of recent years are of more importance to the country than the ore deposits of Gogebic county. This estimate of their surpassing value is, primarily, based upon the superior quality of

the ores obtained, upon the fact of its uniform adaptability to the purposes of steel making.

All the ore, or substantially all of it, which is found in the Gogebic range, is within the Bessemer limit. That is, the percentage of phosphorus contained is sufficiently small to render the ore suitable for the manufacture of Bessemer pig iron. The other qualities of the ore, the metallic iron contained, the silica, etc., also are in such quantity as to commend the ore to steel makers.

When we consider to what extent the rapid cheapening of the cost of steel has caused it to be substituted for iron in the manufacture of rails and other important articles, we are quickly led to understand the superlative value of low phosphorus ores. Steel rails, as we know, are almost wholly used now in place of the iron ones formerly employed, and are infinitely preferable, while costing but a trifle more.

Steel rails are now made and sold nearly as low as the common "pot metal" article, which formerly was the only resource. The substitution of steel for iron in the manufacture not only of rails and of nails, but for other objects too numerous to mention, but all important and indispensable to our use, and all resulting from the Bessemer process, assures the certainty of the demand of the ores which are adapted to this purpose.

The supply of Bessemer ore is limited, and it is apparent that it must continue to remain so, since, with the exception of those of the Gogebic range, there has been little increase in the number of Michigan mines yielding Bessemer ore for several years, notwithstanding the vast amount of exploring that has been done, the numerous discoveries that have been made.

Many deposits of ore have been opened in the past few years in Marquette, and in Menominee counties, but all these, which are of any considerable magnitude, have proved to be non-Bessemer. So that with the exception of the Minnesota mines and the Gogebic, there has been no recent accretion, of any significance, to the number. The increase in the aggregate of the output of Bessemer ores is mainly due to the increased production of the mines already existing.

The Gogebic mines possess unusual facilities for transportation. The railroads use ore cars holding, nominally, 20 tons, but really 24 tons, and are conveying ore to market nearly as cheaply as it is done by vessels.

Thus far the only carrier has been the Milwaukee, Lake Shore & Western Railway, and the nearest lake port is Ashland, Wis., which is distant about 40 miles west from the center of the ore producing portion of the range. At Ashland are three ore docks, two belonging to the M., L. S. & W., and the other to the Wis. Central R. W. Co. The latter at this writing—June 1.—has nearly completed its line to the mines and will soon be ready to compete for the ore carrying business.

Added to these the Chicago & Northwestern R. W. Co. is extending the Menominee River branch from Iron River west to the Gogebic range. This extension will be completed the present season and will then give the mines an outlet to Escanaba on Lake Michigan. Besides the Duluth, South Shore & Atlantic, which has already incorporated into its system the Marquette, Houghton & Ontonagon, and the Detroit, Marquette & Mackinac railroads, is rapidly building its line from Ashland easterly. The line is located two miles north of Bessemer and runs along north of the iron range. When this is completed the Gogebic ores will, probably, have another independent route to the ore docks at L'Anse, Marquette and St. Ignace.

The first ore shipped from the Gogebic range was in the fall of 1885—barely one and a half years ago—and already it has some of the largest producing mines in the country. It is probable that the Colby will send out more ore the current year than any other mine in the State. In fact its product will doubtless exceed that of any mine in any previous year. There are other mines in this range from which, though not so large an amount of ore can be gotten out immediately, are, perhaps, equally as valuable and seem likely to prove so in the long run.

Between the Montreal—which forms the boundary between Michigan and Wisconsin—and the Black rivers, a distance of $8\frac{1}{2}$ miles, occur the best mines found in this range. In this space the formation is remarkably uniform in the occurrence of the rocks, and in their strike and dip. Nowhere in the iron region is there a succession of mines showing so much regularity. Standing upon the high ground at the Puritan, we look east, over the Iron-ton, Tontine, Valley, Colby, all apparently in a straight line. And at the Germania, also, we note in the same way, the occurrence of the Ashland, Norris, Aurora, Pabst, Iron King, etc. All the mines within the limits above given, are opened against the quartzite foot wall, which underlies the ore formation and extends uninterruptedly from the Montreal to the Black, but disappears after crossing the latter stream and going east. This belt of quartzite is an admirable feature of the range. It is an important guide in the work, and moreover it may be remarked that nothing of conspicuous value has as yet been found except where the quartzite occurs and in the high ground. Generally, but poor success has attended the efforts to find ore in the valleys; still, it may at any time prove otherwise, and the low ground may prove equally productive in ore.

East from the Black River greater irregularity is manifest; there is an ore formation but quite different. The belt of quartzite has disappeared, and notwithstanding that a vast amount of exploration has been carried on, no deposits of ore have been found, except to a limited extent at Sunday Lake, that have, as yet, any commercial value.

I have examined the explorations through east from the Black River, to Lake Gogebic, a distance of more than 20 miles, and I find at the present writing, that with the exception of the mines at Wakefield, there is no development which we can assume with certainty will make a shipping mine. There are some that are promising, a few have ore, but none have ore of a quality and in quantity to assure a mine.

West of the Montreal, the mines are all in the State of Wisconsin, but there are none among them that will compare in value with the best mines on the Michigan side of the line.

Commencing at this line, the liquid boundary between the two States I will describe in succession to the east all the mines that are worthy of note or of which I have any knowledge. Of course no mine will be omitted which has any ore, or where there is any good promise of ore.

The first of these mines is the

ASHLAND,

and it is also one of the largest, being second in magnitude only to the Colby. The Ashland mine has improved greatly within the past few months, until now it has developed one of the finest deposits of ore in the State. The estate comprises the S. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$ of Sec. 22, and the N. $\frac{1}{2}$ N. W. $\frac{1}{4}$ Sec. 27, T. 47, R. 47 W. The land in section 22 belongs to the Ayers estate, and that in 27 to the L. S. S. Canal Company. Adjoining the mine on the north is the flourishing village of Ironwood, and west of it on the opposite side of the river, is the village of Hurley.

No. 1 shaft is 250 feet east of the river, near the line between the sections. The shafts are all near this line, but as the trend of the ore is about N. 80° E., and as the dip is north it carries all the ore on the north side of the line—on section 22. The surface rises from the river somewhat gradually, about 40 feet to No. 2 shaft, and thence it is moderately level for some distance, again descending, and becoming what was, until recently, a cedar swamp, in which are shafts 6 and 7, and a little beyond the latter is the east line of the property. South of the mine is a level plat on which the company designs laying out building lots for the men. The seven shafts, with the intermediate test pits, prove the ground pretty well for the $\frac{1}{2}$ mile of the length of the vein. No. 1 shaft is 200 feet deep. They have drifted from it at depths respectively of 150 feet, and one at 175 feet. The deposit of ore has increased in magnitude with increase of depth, until now, at the bottom, there is a maximum width of 40 feet of ore. They were opening the mine, making ready for stopping and hoisting work.

From No. 1 to No. 2 is 285 feet, and a surface rise of 40 feet. The shaft—

No. 2—is only 100 feet deep. It is connected with No. 3 by a drift in the first level through ore 40 to 150 feet in width.

It will not be sunk any deeper at present, but used for hoisting the ore in the levels already opened. Probably 10,000 tons will be taken from No. 2 before the close of navigation.

The great showing of ore is the No. 3 shaft, which is 225 feet east of No. 2, and is 300 feet deep to the fourth level. It descends vertically to the second, and thence follows in the foot wall. The ore is remarkably wide. They are "opening out in rooms," after the manner elsewhere described in other hematite mines. East of the shaft, in No. 3 room, they have a width of clean ore upwards of 200 feet, and still no hanging wall. The ore is scarcely in one body, being divided by about 20 feet of soft chlorite, between which and the foot wall is 145 feet of ore. They went through this and came again into ore, in which they are still cross-cutting. At the time of my visit, May 17, they were opening No. 8 room, 218 feet east of the shaft. The rooms are three "sets" wide, 21 feet each.

The first level is 93 feet from collar of shaft. The second level 150 feet down, third, 200 feet, fourth level, 300 feet.

In all the levels the ore has proved of great width, and nowhere has any definite hanging wall been found. While the ore is very wide it is also very clean—free of rock.

The deposit is of immense magnitude. I examined it sufficiently to satisfy myself on this point. How large it is cannot be stated, as it is only partially opened. Notwithstanding 65,000 tons of ore were taken from this shaft last year, there has been no great impression made in the deposit. There is an abundance of ore in all the levels. No. 4 is 265 feet east of No. 3. It is a new shaft, sunk downright in the foot wall 200 feet. In the third level the shaft is 20 feet south of the ore. It is connected with No. 3 by drift. They were getting ready to hoist ore from this shaft at the time of my visit. A cross-cut north 100 feet was all in ore. Enough had been determined to insure a season's product equal to their best efforts to mine and hoist. At the time of my visit not much hoisting was doing. They were making every effort to complete the tracks of the Wisconsin Central railroad, which are run along by the shafts, so that the ore will go directly into the cars from the skips, or into the ore pockets placed over the track by the shafts. The railroad tracks are built and owned by the mining company, and extend to all the shafts.

From No. 4, east to No. 6, is a long stretch of ground, 820 feet. This ground, however, has not been wholly explored; a number of test pits have been bottomed in ore. Even No. 6 and No. 7 shafts are new work, sunk within a

few months past and are even now getting in readiness for hoisting. As they are in low ground they were flooded with water when the snow melted in April. Heavy ditching to the south, to the river, will be required to secure immunity from this danger. These shafts are 300 feet apart, each is 129 feet deep, and No. 7 is 465 feet west of the east boundary.

They are sunk in a large body of ore; the best ore found in the mine. A cross-cut 80 feet north is all the way in clean ore, and the rock encountered at the end is chlorite, so that I think that the ore will be found to continue north after the soap rock is cut. The shafts are connected, all in ore; in fact, the length of opening in the 2d—the bottom level—is 600 feet east and west, and they are still driving both ways, in ore. So that I was enabled to pass through a length of 600 feet of ore, and a width of 80 feet, and a depth of more than 100 feet, in this end of the mine.

They will hoist this year from six shafts. Last season but three were used, but most of the product was taken from No. 3. The company has sold 180,000 tons of ore, but if the mine is pushed and they have the lake transportation, a much larger product than that can be mined; 500 men are employed. The rate contracted from Ashland to Cleveland is \$1.75 per ton. Since the mine was opened four men have been killed.

A change house has been built, and is about ready to use. Everything is new and somewhat in a confused arrangement. The mine has developed beyond their expectations, probably, and after a little time things will be made adequate to the requirements. A new engine house has just been built at the east end for the machinery to operate 6 and 7. The two drums are 6 feet diameter, made at Marietta. The mine is dry. There is very little trouble with water, ordinarily. The ore is soft hematite, mines very easy, requiring very little blasting. It also stands well in the stopes. It is uniformly good ore, equal to any found in any mine in the range. The average of the ore shipped last year was 64% in iron and .042% phosphorus. It is possible that it will average some better in 1887, owing to the superior quality of the ore found in the east end. Some of the ore runs very high in iron and equally low in phosphorus, as shown by analyses.

The officers are Chas. C. Colby, President, Milwaukee; W. H. Abbott, Secretary, Milwaukee; E. A. Hayes, General Manager, Huelo, Wisconsin; John A. Taylor, Superintendent of mine; W. J. Olcott, Managing Engineer and Chemist.

At the east end it is the plan to mine out all the ore, carrying the stope on top of the ore body towards the shafts. The only criticism I have to offer is that the main drift is in the center of the ore body, instead of along the walls. It seems to me better in this plan of mining, to follow the method of the Cleveland Hematite. That is safe and expeditious.

The mine shipped in

Year.	Tons.	Year.	Tons.
1885.....	6,471	1886.....	74,015
Total.....			80,486

It is not probable that there is a continuous run of ore the entire length of the property, but is probably a succession of lenses that closely lap each other, dipping north and "pitching" to the west. These may be equivalent to a single body, reaching the whole length of the land.

Adjoining the Ashland on the east is

THE NORRIE MINE,

which is the property of the Metropolitan Iron and Land Co. The mine is in the S. $\frac{1}{2}$ S. E. $\frac{1}{4}$, Sec. 22, T. 47, R. 47, the fee of which is owned by the estate of J. C. Ayer, from whom the mining company holds a lease with the usual royalty for the ore. The ore formation runs the long way of the 80—one half mile, and as this company also holds the W. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$, Sec. 23, which adjoins on the east, it really has a length of ore formation of three-fourths of a mile—N. 80° E. The Norrie is one of the four chief mines of the range and is, perhaps, thus far, the most systematically worked of any.

There are seven shafts in all but the best ones—those affording the larger portion of the ore are at the west part of the mine. No. 1 shaft is a new one, at which they are just now erecting a plant of machinery to operate it. It is 180 feet east from the west line, and is 100 feet deep, and they have drifted each way to east and to west at the bottom, 25 feet, and have cross-cutted to north 20 feet, in the west side of the shaft. These drifts are all in ore, so there is no doubt of having a good lense of ore in this shaft. The Norrie ranks second only to the Colby in the matter of shipments. The mine is wholly underground and systematically arranged in "rooms" and pillars, and timbered in good shape after the Nevada system.

The maximum length of the main pit is about 850 feet, and the width at the east end in the bottom is more than 110 feet. They have a cross-cut 110 feet, all in ore with no rock yet. The maximum width of ore in the second level, 175 feet down, was 160 feet. The west shaft in the main working pit is No. 3, which is about 700 feet east of No. 1, and is 250 feet deep. It was started in ore on the foot wall at the surface, but at the second level the foot wall "makes" north 20 feet from the shaft; and at the third level it is 50 feet north. East of the shaft it is 100 feet, as is shown by a winze that starts in the second

level 100 feet north of the foot, but in sinking it vertically the foot is struck in the third level, showing that in this distance down the foot wall has flattened and gone north 100 feet. However, further on east, at No. 5, the foot wall is back to the south, the excessive flattening being confined to the west end.

It is probable that No. 3 is at the upper end of the ore lense that dips north with the formation, and inclines to the east in the same manner, as may be seen at the Colby.

A peculiarity of the foot wall in the west end of this pit is the sand. The quartzite is changed to sand; and there are also bunches of sand—disintegrated quartz boulders—in the ore. The occurrence of sand in the ore, of sand in the walls, of quartz boulders in the ore is common in the mines in this range. It is found to some extent in all of them, and sometimes there is too much sand, or, of its equivalent, rock.

No. 4 shaft is 350 feet east from No. 3, and No. 5 is 195 feet east of No. 4. Each is 250 feet deep, down to the third level.

In No. 4 no opening work has been done in the bottom. It is pretty wet. It is better to get a level beneath the one that is opening, to take the drainage. The ore that is worked in can be thus made dry. In the second level, in No. 4, the ore, except the pillars, is all worked out, and it is possible that below the third level the ore is cut out by the underlay of the foot wall and the easterly pitch of the lense.

No. 5 is opened pretty well in the third level, and is looking finely. The drift from the shaft east is 150 feet, and still in good ore. Possibly the ore will continue to No. 6 shaft 300 feet from No. 5. Certainly it has lengthened east, since in the second level it only extended east 140 feet. The shaft is in the foot wall, and they cross-cut north to the ore. A cross-cut in the ore is in 110 feet, but not yet through it as I have previously stated. The ore is clean and first-class.

No. 6 shaft is 300 feet east from No. 5. It is sunk on the hanging wall side, inclining to the north at an angle of 60°. It is now, May 15, 175 feet deep. They will reach the ore by cross-cuts south.

No. 7 shaft is 350 feet east from No. 6, and is 150 feet deep, and shows a deposit of ore about 5 feet wide. It is idle at present. The Norrie ore averages about 62% in metallic iron, and about .042% in phosphorus.

The mine is well provided with machinery, adequate to present needs. Unfortunately there is a good deal of burden on the surface over the mine, and experience has shown the instability of mines upheld by timbers. Ultimately to extract the pillars, the mine must be filled, and it would be cheaper to do that on the start. There are 35,000 tons of ore in stock.

The mine produced in

Year.	Tons.	Year.	Tons.
1885.....	15,420	1886.....	124,835
Total.....			140,255

The officers are S. S. Curry, President, Ishpeming, Michigan; H. S. Hazelton, Secretary, Milwaukee, Wisconsin; R. H. Hanna, Treasurer; Jeff. D. Day, Superintendent; Wm. Treblecock, Mining Captain, Ironwood, Michigan.

THE EAST NORRIE,

owned and operated by the same company, is situated in the N. W. $\frac{1}{4}$ S. W. $\frac{1}{4}$ Sec. 23, adjoining the Norrie. They are working one shaft, and are opening another one. The total length of opening east and west is about 250 feet, and the depth is 150 feet, and the greatest width of ore is about 40 feet. Are working 30 men, and will get out about 10,000 tons the coming year, it is estimated. The mine has been changed from open pit to underground. The ore is the same as at the Norrie. The mine yielded in 1886, 10,160 tons of ore.

D. E. Southerland, Mining Captain.

THE AURORA,

the property of the Aurora Iron Mining Company, is one of the chief mines of the Gogebic range. Its owners claim it to be second only to the Colby in magnitude. The mine lies east of the Norrie and southwest of the Pabst, the estate being the N. $\frac{1}{2}$ of S. E. $\frac{1}{4}$ Sec. and the E. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$ of Sec. 23, 47, 47; the former belongs in fee to the L. S. S. Canal & Iron Co., and the latter, E. W. Sparrow. They are held on 20 years' leases by the company, the consideration being that the company shall mine, or pay royalty of 60 cents per ton on at least 10,000 tons of ore annually. For all amount in excess of 10,000 tons the royalty is 50 cents.

The two 80's form an L shaped figure, the east 80 being south of the Pabst and formerly known as the Vaughn.

The first exploring work was done on this property by the Cambria Iron & Steel Co., in 1882 that relinquished its option, after which the property was held by Capt. N. D. Moore.

As with the others, systematic mining work has been in progress scarcely two years, but here it has resulted in important results, to wit, the development of a very large amount of most excellent ore.

The Aurora, unlike its neighbors, was first worked open cut at the west end,

and they are preparing to "strip" the ore at the east end, preparatory to proceeding here on the same method.

The open pit at the west end—the original Aurora mine—is about 400 feet in length, with a surface width of 150 feet. The ore is covered with an average depth of dirt and rock of 20 feet. In the work of stripping, one of Fayette Brown's patent conveyors is used; it comprises an iron bucket holding one and a half cubic yards of earth attached to a wire rope; when filled the signal is given, the bucket quickly ascends vertically up to the horizontally suspended rope, which answers as the track for the shieve, that runs the load away over to the north of the mine, where it is dumped, and then as speedily returns and is lowered into the mine; the rope is attached to another bucket that has been filled during the absence of the first one, which is in the same manner taken to the dumping pile. So the work of stripping goes on uninterruptedly, night and day.

In this west end mine are two shafts, 1 and 2. The former is 950 feet east from the west line of the property, and is 120 feet deep. At 60 feet down, a drift north gave a width of ore 140 feet.

No. 2 shaft is east from No. 1, 145 feet, and is 140 feet deep—15 feet stripping, 125 feet of ore. Sixty-five feet down a cross-cut north found 146 feet of ore. The ore is entirely free of rock, and of the best quality.

No. 3 shaft is 480 feet east of No. 2, and they are nearly connected by drift at 100 feet below the surface. The drift is all the way in ore. The shaft is 145 feet deep, and all in ore below the stripping. Several cross-cuts have been made to the north at different depths, showing a width of ore of from 20 feet to 30 feet. All the ore taken from the shaft has come from the openings.

No. 4 shaft is 285 feet east of No. 3, and in sinking it passed through 10 feet of dirt and 13 feet of rock, when the ore was reached, which has been penetrated by the shaft 167 feet.

In the first and second levels, 50 feet and 110 feet down respectively, the ore was found to be about 10 feet wide, while in the third level, 150 feet down, it had increased to a width of 30 feet.

The shaft is connected by drifts with No. 3 and with No 5, and is used for pump and timber shaft.

No. 5 shaft is 140 feet east of No. 4. Two drifts have been cut to the east, one at 60 feet down and one at 110 feet. The first showed six feet of ore, the lower one about 10 feet, and at the bottom, 150 feet below the surface, the ore is 30 feet wide.

No. 6 is 300 feet east of No. 5, and No. 7 is located 300 feet east from No. 6. They are only to the ledge, but both in ore. A summary of the work shows a total of 770 feet of length of shafts, 200 feet of winzes, and 2,350 of drifts.

The length of deposit tested is about 1,500 feet. •

The railroad track extends along by the shafts, and the pockets receive the ore direct from the skips.

I was informed that about 30,000 tons of ore had been sent to the Joliet steel works by rail. It is estimated that a product of 200,000 tons will be shipped during 1887.

The machinery consists of two steam boilers, each 60"x18', 6 pumps and 5 winding drums. Four of the shafts are provided with skips, and ore pockets are at shafts 1 and 2, and they are also building pockets at Nos. 3 and 5.

The buildings comprise office, shops, three engine houses and one boiler house; also dwelling houses.

The Aurora is one of the series of mines controlled by Messrs. Moore, Benjamin & Co.

N. D. Moore, President, Milwaukee, Wisconsin; H. S. Benjamin, Secretary, Milwaukee, Wisconsin; C. F. Rand, Treasurer, Milwaukee, Wisconsin; Richard A. Parker, General Manager, Hurley, Wisconsin; N. Hibbert, Superintendent, Ironwood, Michigan.

The product of the mine in 1886 was 97,659 tons, which sold at an average price in Cleveland of \$5.05. The railroad freight to Ashland was 80c., and the average lake freight to Cleveland was \$1.68.

The ore averages in metallic iron 62% to 64% and .035% to .040% in phosphorus, 3.20% silica.

THE NORTH AURORA MINING CO.

The North Aurora, so called, is a new undertaking, lying north of the Aurora in the S. $\frac{1}{2}$ N. W. $\frac{1}{4}$, Sec. 23. A shaft is sinking near the Aurora line to find what is called the north vein. At the time of my visit there were no indications of ore in the shaft. The projectors claim to expect to find the main ore bodies on this property, and ultimately to catch the Aurora ore in the underlay to the north, as the Aurora shafts are not very far from the north line of the property.

The officers are, John Paulson, Minneapolis; O. J. Nevitt, Minneapolis; Matt Fitzsimmons, Ironwood, Mich.

Directly east from this is

THE PABST MINE,

in the S. $\frac{1}{2}$ N. E. $\frac{1}{4}$, Sec. 23. It is one of the best equipped mines in the range. The drums, new ones, are six feet diameter, besides four, not used, three and a half feet diameter; two cupola boilers 125 horse power each, and two locomotive boilers, National Compressor, with capacity of 12 drills, of

which number eight are used; Rand's three skip, two tons capacity each, and two of one-half tons each; seven tram cars, good ones, each one and a half tons capacity and full equipment of pumps.

The engine house is large and substantial. The structure over the shafts for ore pockets, elevated tramway, etc., are strong and substantial. There are also the other necessary buildings.

The property has a full half mile in length of the ore formation, and the full width of the portion that has proved productive in the mines to the west, that is, it holds what are called both the north and the south veins.

But the ore deposits, so far as shown, are by no means as large as are found at the other mines in this vicinity, that is, at the Aurora and at the Iron King.

The Pabst has four working shafts. No 1 is 45 feet west and 360 feet north of the southeast corner of the property. It is sunk vertically, 124 feet deep, and is 8' x 18' outside measurement, divided into three compartments. They are now sinking in it for another level. The ore body is 15 to 20 feet wide and 75 feet long; there has been taken of it from the shaft 7,500 tons. They are also exploring north with a drift, are in mixed ore and rock. The drift is in 12 feet only.

No. 2 shaft is 330 feet west from No. 1, and 100 feet deep, inclining to the north at an angle of 60°. It is sunk in the foot wall. They have drifted west 80 feet and east 70 feet, and have ore 30 feet wide; but it is not first-class, that is, there is more or less rock in it. There is only one level, the ore body extends down from 25 feet below the surface.

No. 3 shaft is 202 feet west of No. 2, and it has an equal depth; it is the main shaft of the company, is in the foot wall and reaches the ore by cross-cuts. A singular occurrence in driving this cross-cut in the bottom, illustrates one of the peculiarities of this formation—the finding of sand in the foot wall in place of the solid quartzite. In this instance the cross-cut, 50 feet long, in the bottom, proved to be in sand and being saturated with water, it was nearly impossible to keep a drift through it. They succeeded only by drawing out the sand until it became exhausted and by filling in with rock from the surface.

In the bottom level in this shaft they have gone east 17 feet—to the rock—and west 70 feet. The ore is about 40 feet wide. They are still stoping west. In this breast stope there is some sand mixed with the ore, and on the foot wall side are concretions—iron nodules, etc., in the ore. The pit is pretty wet—"droppy." In the level above the length of ore west was 117 feet. The shaft is 127 feet north of the south line of the land.

No. 4 shaft is 232 feet west of No. 3. It is sunk in the hanging wall and is vertical, 145 feet deep, 7' x 9' inside of the timbers. The plan is to sink 40 feet more and then open another stope. The shaft has cost \$30 per foot,

including the timbers. The ore is harder than in some of the mines here, and in sinking the shafts considerable rock is penetrated, so that the power drills are quite an advantage in pushing the work.

They are sinking a shaft for the north vein, 450 feet west of No. 3. It is now clean 55 feet, with no signs of ore as yet. They hope for better results when twice the present depth is attained. At this date—May 18—the company has shipped 3,000 tons of ore, and has 14,000 tons in stock at the mine. They expect to reach a product of 50,000 tons and upwards. I doubt if they exceed that amount very much.

Southeast from the mine, on the S. W. $\frac{1}{4}$ of Sec. 24, a village has been platted—Jessyville—where is already a postoffice and half a dozen saloons, etc.

The property is favorably situated. I can see no reason why as much ore should not be found on it as on any land in the range.

The officers are, Fred Pabst, President; Chas. Best, Jr., Vice President and Treasurer, Milwaukee; Henry Baest, Secretary and General Agent, Ironwood; Richard Kitto, Superintendent.

The average selling price of the ore in Cleveland, in 1886, was \$4.51. Railroad freight to Ashland, 80 cents per ton. Lake freight, \$1.73.

The mine produced in

Year.	Tons.	Year.	Tons.
1885	1,153	1886	17,925
Total			19,078

The following are some analyses of ore from the different shafts, made by Mr. C. E. Wright and others:

Metallic Iron	64.37%	Phosphorus .....	.047 %
“ “	66.17%	“ .....	.024 %
“ “	62.75%	“ .....	.023 %
“ “	59.92%	“ .....	.0215%
“ “	65.17%	“ .....	.038 %
“ “	60.55%	“ .....	.026 %

NORTH PABST MINING COMPANY

is the title of an organization engaged in exploring in the land north of the Pabst, to wit: the N. $\frac{1}{2}$ N. E. $\frac{1}{4}$, Sec. 23. So far the work done is sinking test pits, etc.

THE IRON KING MINING COMPANY

is to be congratulated on the fact that its mine is proving so valuable. Few mines on the range have changed for the better, recently, so greatly as has the Iron King. From being property of doubtful value, it has advanced into the front rank, and promises to be a first-class mine. The property joins the Pabst, being the N. W. $\frac{1}{4}$ of section 24—160 acres. Thus there is a full half of a mile of the ore formation in length, in the property. The line of the foot wall at the west side of the land is but 400 feet north of the S. W. corner, so that there is more than 2,000 feet at this end for width of ore formation on the property. The bearing of the foot wall is about N. 45° E., and thus it crosses the west line at about the same distance from the N. E. corner as on the west side it is from the S. W. corner. There are three shafts in the so-called north vein, the most westerly one of which is No. 1, which until lately was an open pit. The shaft is now 225 feet deep, dipping north at an angle of 65° . It is opened in two levels. In the bottom they had gone 65 feet east and 50 feet west, all in ore, and the ore still continuing both ways. This level is 207 feet below the surface; a cross-cut north shows the ore to be 56 feet wide. It is nearly all clean. There is rock found at only one point in the cross-cut. They commenced stoping in this level last April. The first level is 60 feet below the bottom of the open pit, and they have drifted west in it 60 feet from the shaft, and east 209 feet, to connect with No. 2 shaft. The average width of the ore has been about 20 feet. Fifty feet below the ore was drifted in, east of the shaft, 35 feet, and cross-cutted north, 36 feet, all good ore, giving by analysis 64% of metallic iron, and .035% phosphorus.

The shaft is in good shape, well timbered, they operate in it a two ton skip. Thus No. 1 affords ample assurance that it will furnish a good quantity of ore.

No. 2 shaft is 209 feet east, and, as above stated, is connected with No. 1 in the first level. The latter is 115 feet below the surface, being 50 feet beneath the bottom of the old open pit. The ore has been stoped away between it and No. 1, and to the east for about 100 feet, the average width being 10 or 15 feet. The end of the drift east 25 feet is rock. The second level is 65 feet below the first, and at 36 feet west of the shaft further connection is made between them by means of a winze. A cross-cut north went through 36 feet in width of ore. The third level is 80 feet below the second—260 feet below the surface. In it they have driven west nearly to No. 1 shaft, all the way in ore, after cross-cutting through 22 feet of rock at the shaft. The drift east from the shaft in the third level is 30 feet long, ends in rock, but a cross-cut north from the shaft 40 feet in length, is all in ore. The ore runs at about 62% in metallic iron and .030% in phosphorus.

The open pits, through which these shafts are sunk, comprised the working portion of the mine in 1886.

In the two shafts is now opened a length of ore of 360 feet, showing a maximum width of 50 feet.

There is a new shaft house at No. 2, with plant of machinery that operates a two ton skip in the shaft.

No. 5 is the third of this line of shafts. It is 800 feet east of No. 2, and at this date—May 18—is 85 feet deep. The shaft passes through 75 feet of earth and rock capping, and then comes into fine ore. The ore body at No. 5 has been tested by means of a test pit, which is north of the line of the shafts, and which they sunk 65 feet when ore was reached, in which they cross-cutted south, 62 feet in ore. They are now sinking in this ore to test its depth. They have drifted west in it 30 feet in ore.

In the south vein, so called—the ore that lies on the quartzite belt—the company has two shafts, Nos. 3 and 4. The first named is near the Pabst boundary, about as near to it as it can be. It is about 55 feet east of the Pabst, No. 1 shaft, in which a good width of ore was found and stoped out up to the line between the properties.

But the Iron King people don't seem to find it on their property as yet. The shaft is down 100 feet, and a winze has tested the ground 20 feet still deeper; some cross-cutting and drifting has been done. They are sinking the shaft intending to go down about 150 feet, and then drift and cross-cut.

No. 4 shaft is affording far better results at present writing. The ore was first found in a test pit, sunk to a depth of 20 feet, and then cross-cutting in the ore 30 feet. After this the shaft was begun, which is now 150 feet deep. It is on the high ground south of Nos. 2 and 3 shafts. The first level is 70 feet from top, and the second 135 feet. The work was begun in Nov. last.

The ore has been found 60 feet wide in the first level and have drifted west in it 35 feet. No drifting east.

In the second level they have drifted west 90 feet and east 30 feet, both in ore, and ore in the breasts of the drifts. The ore has been crossed with a drift to the north, a distance of 55 feet, and still not to the hanging. Thus pretty well demonstrating the fact that there is a great body of ore to be opened in this shaft. The shaft is about 1,000 feet east from the west line. Altogether it is pretty certain that the Iron King is to be a great producer of first-class ore. It is an important feature that none of the other mines show, except the Colby, that at the Iron King are two series of ore deposits running with the formation, two veins they are called, which if they are found to continue across the property will give the mine great value. They are making surface preparations to render the machinery and other requirements adequate to the needs of a

large output. An ore pocket is building at No. 4, and the railroad is extending to it. The ore pocket is to be a large one having a capacity of 1,000 tons of ore. It will have sufficient length to enable them to load half a dozen cars at one time. A similar pocket will be built at No. 1 and at No. 2 shafts. The railroad branches are connected with M., L. S. & Western main line. There are at the mine, it is stated, 780,000 feet of logs, 300,000 feet of square timber, and 100,000 feet of plank, all to be used in the mine and in surface work. There are a number of dwellings, a large boarding house for men, and other necessary buildings, among which is a good engine house containing a plant of hoisting machinery of W. C. & Lane manufacture—drums 6' diameter. The force employed averages now 160 men. They expect to ship, the present season, 75,000 tons of ore.

The ore averages 61% to 63% in iron, and below .040% in phosphorus.

The officers are, John E. Burton, President, Milwaukee; J. G. Sherman, General Manager, Hurley, Wis.; E. J. Severson, Assistant General Manager; Chas. Whitford, Mining Captain, Hurley, Wis.

Shipments for 1886 amounted to 27,343 tons. Average price in Cleveland, \$5.00 per ton. Railroad freight, 80 cents; average lake freight, \$1.30.

THE BONNIE IRON MINING COMPANY

is the proprietor of the quarter section of land which joins the Iron King on the east, being the N E. $\frac{1}{4}$ of Sec. 24. The Bonnie is one of the series of what is known as the "Burton mines." This list comprises the Iron King, Bonnie, First National, Blue Jacket and the Valley. Of these the first mentioned is the only one that, at the present writing, affords absolute assurance of being a profitable mine, or of being a property that contains enough ore to make a mine of much magnitude or profit. Still, I can see no reason why ore may not exist at the Bonnie in as large quantity as at the Iron King, only so far, it has not been found. The ore is not clean. It is mixed, ore and jasper. A good deal of exploring work has been done in the way of sinking test pits, both in the north and south veins, as they designate them. In the latter, next to the quartzite, six shafts have been sunk, No. 1 of which is 250 feet from the east line of the west eighty. It inclines to the north with the foot wall, at an angle of 60°, and is 100 feet deep. At 50 feet down a cross-cut was made to the north 36 feet, through very good ore, and they drifted west along the foot wall 60 feet, and east 20 feet, all in ore. Analyses shown gave 60% in iron and .030% in phosphorus. At the bottom they have not cross-cutted, but had drifted west about 40 feet in ore. They are rigged for making a stock pile at No. 1 east from the shaft to the railroad, which comes along at the east end of the bluff. The hoisting in the shaft is done with a bucket.

From No. 1 the ground rises to the west in the direction of No. 2, which is 190 feet distant. It is a skip shaft, but has been idle since last fall on account of the water. When connected with No. 1 the latter will take all the water. The shaft is 90 feet deep, and they have drifted west in the bottom 75 feet, in what is called ore. I did not see this, as the shaft held too much water. I only judged from the stock pile.

No. 3 is still further west 200 feet, and in still higher ground. It is 60 feet deep, and is worked with a windlass. The shaft shows mixed ore and rock. It is in what is called the "capping," the rock which overlies the ore.

No. 4 is 200 feet west of No. 3, and is 100 feet deep. It is idle. The shaft holds a small vein of manganiferous ore, or very high in manganese. One analysis of this ore gave 27.50% manganese and 37% iron, .027% phosphorus. The deposit is two to four feet wide, and is not continuous. It gives way to rock. Cross-cuts in this shaft did not develop anything of value. The "ground" is hard and unpromising.

No. 5 is 175 feet west from No. 4, and is 65 feet deep. It is worked in open pit. They have mined here 700 tons, and will continue to take out ore, as the ore is five feet to 8 feet wide. The surface dirt is eight feet, resting on the ore. Gone east 35 feet, but west is rock.

No. 6 is 150 feet west of No. 5, and is 38 feet deep. It is in mixed ore and rock.

In the north vein is a shaft 75 feet deep, in which a little ore was found. It was worked last year, and it is the intention to work it again soon. They will sink it deeper and cross-cut the formation. There are many other pits on this north vein, but none containing good ore, so far as I know.

This formation—the quartzite foot wall—runs diagonally across the north end of the west "eighty;" some work has been done on the east half of the property. Pits commencing 200 feet east of the line, which divides the $\frac{1}{4}$ section north and south were, Capt. Jones tells me, "bottomed" in ore. Considerable difficulty attends exploring here, as the ground is wet, and the drift is 21 feet deep before reaching the ledge. It is the intention to wait for dry weather, in the latter part of summer, and then prosecute the work.

Just now all effort is making to complete the railroad track so as to get to shipping ore. The force employed was, at the time of my visit, May 15, 40 men.

The best outlook for the mine is at No. 1 shaft. Up to the present time no ore has been shipped, though there are several hundred tons in stock.

John E. Burton, President; John A. Kennedy, Secretary. General office 408 Milwaukee street, Milwaukee. J. G. Sherman, General Manager, Ironwood, Mich.; E. H. Jones, Mining Captain.

THE FIRST NATIONAL IRON MINING COMPANY

is working in the N. W. $\frac{1}{4}$ of Sec. 19, which lies next east of the Bonnie. The company, however, holds the quarter section adjacent on the north, to wit: the S. W. $\frac{1}{4}$ of Sec. 18, thus making the total number of acres held 320.

Here, also, considerable exploring work has been done. The land was among the first to be tested for ore, but so far it cannot be said the result has been very encouraging.

It is reached by a branch from the main line of the M., L. S. & W. railroad, which latter runs through the north part of Sec. 18. The same branch passes first to the Blue Jacket, and then continues on to the First National.

Just now the work of the mine is concentrated in two shafts, No. 1 and the A shaft. The former is 110 feet deep, with a cross-cut at 55 feet down from the top and 32 feet north. They have drifted east 75 feet from the shaft in mixed ore and rock for 30 feet, and then for 45 feet it is pretty good ore. At the bottom, 55 feet below first level, they drifted west, but the ore disappeared. They are now drifting east, and are in ore; have also cross-cutted in 15 feet of ore east of the shaft.

Shaft A is 435 west of No. 1, and is 90 feet deep. The first level is 66 feet down, and in this they have drifted both east and west from the shaft—west 80 feet in a sort of second grade ore, that is, the drift is in ore, but it is not clean ore. At 60' in west is a raise 20 feet, also in the same ore, and the shaft itself continues down in ore.

The drift is east of this shaft 25 feet, with a cross-cut north 20 feet, both in ore; that is, there appears to be pretty good ore all along on the bottom of the drifts, and in the sides near the bottom. It seemed that they were on top of a deposit of ore.

Considerable money has been expended for surface improvements. There is a fine office building, Superintendent's house and other dwellings, good engine house, etc. The plant of machinery comprises two 5-foot drums, Lane pattern. Were working 35 men.

From A shaft the surface ascends quite steeply to the east, and in this hill, east from No. 1, the most of the mining work has been done. One shaft is 115 feet deep, but there is too much rock in the ore, also it carries a good deal of manganese.

The best out-look just now is in the A shaft, down under the hill to the west, but one cannot safely predict great things even of this shaft.

The First National has a capital stock of \$2,000,000—80,000 shares—which are quoted now as having a market value of \$7.50, which would give a cash value to the mine of \$600,000. This is for a property held on a lease for a limited period.

The Bonnie has a capital stock of 40,000 shares, par value of \$25 each. They are quoted as having a market value of \$13.00, \$520,000 for the mine, with the ore, or any considerable quantity of it yet to be found.

I merely call attention to this to show the extravagant estimate that is made of these properties, many of the mines, so-called, in this range. The Ashland, for instance, is quoted at \$40 per share, 40,000 shares, \$1,660,000. A large sum, certainly, but even then the stock is cheaper than the major portion of the stocks of the mines in the Gogebic Range would be at one-hundredth of that figure. There has been a great deal of money made in manipulating the stocks of the Gogebic Range, and some of the stocks will prove a good investment. But on the other hand, there has been, no doubt, a good deal of misrepresentation and fraud, and some of the financial gains represent equal losses. Money acquired by the sale of stocks that are valueless, is to the same amount a loss to the unfortunate purchasers, who had, perhaps, in good faith, acquired the stock. The Gogebic stocks have been scattered over the country, and many purchasers will suffer severely from their ultimate great depreciation in value. These remarks are not introduced here to apply to the First National, but with reference to their application to the over estimate of the value of the stocks of the most of the mines in this range.

President of First National Mining Company, John E. Burton; General Manager, J. G. Sherman; Joseph H. Johns, Mining Captain.

THE BLUE JACKET IRON CO.

holds the quarter section of mineral land adjacent to the north half of the First National property, to wit, the S. E. $\frac{1}{4}$ of Sec. 18. The land is in all respects favorable for the occurrence of ore, and for the prosecution of mining work; but unfortunately for the owners, very little ore has yet been found.

There are four shafts sunk on the foot wall, but at the time of my visit they were working in but two of them, the east one of which is 160 feet deep. In the bottom of this—No. 1—they are drifting west, and had just come into ore when an excess of water, which came in in the drift, interrupted the work. No. 4, the west shaft, is about 300 feet from No. 1. Nos. 2 and 3 are between these extreme ones. So that at present the work seems to be concentrated upon a short stretch of ground. No. 2 is about 60 feet deep, and is in ore; Capt. Harvey says, 15 feet to 20 feet in width. This is the body of ore that they wish to reach and mine from No. 1, when they have fully provided for disposing of the water. They are also busy building two ore pockets to receive the ore when hoisted. The pockets are over the railroad track, and are connected with the shafts by elevated tram roads. There is also a small amount of ore

in stock. The engine house is furnished with two drums for hoisting, $4\frac{1}{2}'$ diameter each, Bullock's pattern; one for No. 1, and the other for No. 4 shaft.

The other explorations on the property have not developed ore.

John B. Burton, President; J. G. Sherman, General Manager; J. H. Harvey, Mining Captain.

THE NEWBERRY

is the title given to an exploration in progress, consisting of a shaft just north of the wagon road, that runs along the range. It is just north of the Bonnie in the S. E. $\frac{1}{4}$ of Sec. 13, 47, 47. The shaft is 75 feet deep, the time I saw it—May 19—and in a quartzitic flag.

THE NORTH IRON KING

is another exploration just begun in similar location as the above; but north of the Iron King mine, in the S. W. $\frac{1}{4}$ of Sec. 13. Wm. Hockin has charge of the work and some Minneapolis men furnish the money.

THE PURITAN MINING COMPANY

operates on the quarter section lying east of the Blue Jacket. The Puritan is in high ground, apparently as elevated as any in the range. It is on a level with the Colby, which is situated a mile to the east of it in the bluff on the opposite side of the valley that separates them. A spur from the Blue Jacket railroad branch runs east across the Puritan land, and gives a track along on the foot wall south of the shafts. Another track, the Iron-ton Mine branch, which comes in below the bluff to the east, is extended southwesterly, bending around the bluff, so as to afford a place for ore dock and pockets to receive and transfer the ore taken from No. 1, the east end of the mine.

The description of the property is the S. W. $\frac{1}{4}$ Sec. 17, T. 47, R. 46, and the mine is all in the east half of the property, adjacent to the quartzite foot wall. To the north and west of the mine the ground has been a good deal explored with test pits, most of which were sunk to the ledge, and show in the debris about them a mixed ore and jasper. West of the mine, a few hundred feet, is a railroad cut about four feet deep, in the ledge, and 100 feet long, diagonally across from the quartzite foot wall, northwesterly. It cuts through a very rich jasper, that is, through ore which is too high in silica to be merchantable, but it affords excellent indications for finding ore, possibly at greater depth. Not unfrequently in this range, lean or mixed ore is succeeded in depth by that which is clean and marketable.

In the Puritan there is a full half mile of the ore formation—of the quartz-

ite foot wall, against which, or lying on which, all the best ore deposits have been found, and north of this it is about 800 feet to the north boundary, a little beyond which an exploration, now in progress, develops a formation of black slate.

The mine was first opened at the east side of the property, where the land descends to the east. Here the most of the ore thus far mined has been found. This ore deposit is divided with the Ironton. The boundary crosses the ore and both companies mine to the line. This is a fine deposit of ore, and the product is cheaply secured. The bottom of this pit is now reached by two shafts; one on the foot wall, No. 1, called also the skip shaft, and another about 12 feet southeast of it, sunk vertically from the surface in the quartzite foot wall. It is called the rock shaft. Hoisting is done in it with a bucket. The ore has been mined out, both in this and in the Ironton, and the top allowed to fall in, so that there now appears a long open pit, which is 200 feet in length on the Puritan side, about 50 feet in depth, and a surface width of 100 feet.

The skip road is 132 feet west of the east end of the mine and the whole length of the underground opening in the first level, 90 feet down, is 220 feet. Eighty feet from the shaft, west, is a cross-cut north 45 feet in mixed ore and jasper. The length of the ore body is about 180 feet east and west.

Descending a winze, which is near the cross-cut, 27 feet, brings one to the bottom of the second level. It has been opened 132 feet east, to the line, and 136 feet west, in all 268 feet.

The breast of the drift west is looking well. There is a "leader" of ore which, if followed, may lead into a much larger body of it. The average width of the ore in this level is about 40 feet, for a length of 180 feet and a depth of 27 feet, substantially all standing in the mine. The drifts have been made along the walls, and timbered, and the work of removing the ore has begun. Commencing at the east line and working towards the shaft, stoping off the end of the ore, and letting the ground "run in" from above after the ore is removed. There is a level partially opened under this 23 feet further down, 140 feet from the surface. The drift west along the foot is 26 feet, and east 100 feet, and the cross-cut south from the face of the foot wall to the rock shaft is 27 feet long. The ore has not been cut through north, but in the Ironton, which is deeper than the Puritan, the ore has increased in width, so that there is no apprehension of any diminution in the Puritan. It is entirely clean ore, no rock to sort out. It is hoisted up both the shafts, and run down to the ore pockets, 600 feet south, on a gravity incline. The pockets are 40 feet above the railroad.

No. 4 shaft is the next most important one. It is 1,290 feet west from the east line, and is 115 feet deep, inclining 65° north on the foot wall. The first

level is 65 feet down from the top. About the shaft it is mixed ore and rock, and so continues west 60 feet, where good ore is reached, 20 feet in width. The ore holds for 70 feet, and is followed up to the surface dirt on an incline of rock, which separates this ore from a body of equal length west of it. The partition wall is about ten feet thick, and dips east at about 45° . The westerly lense has a width of upwards of thirty feet, all in ore. East of the shaft the ore is mixed with rock, and requires picking. At about 50 feet east is a drift to south 10 feet, to the quartzite, and at 60 feet in is a cross-cut north 40 feet. Both these are in the same formation that is found in the main drift. Above the first level, about 20 feet, clean ore is found 10 feet in width, which has been drifted and stoped in 60 feet west and 70 feet east. I judge that it extends up to the surface dirt, and that it continues yet further both east and west. The end of each drift is ore.

The second level is fifty feet below the first, and is opened west about 50 feet, worked out to a width of from 10 to 20 feet. It is in not fully clean ore, but by careful picking the ore is saved. East of the shaft it is only opened far enough to make room for a No. 6 Knowles pump.

No. 3 shaft is 325 feet east of No. 4, and is but 80 feet deep. The ore is 25 feet in width, and the drift west in ore is 40 feet, where it runs up westerly on an incline of rock, showing, as in No. 4, that this ore pitches to the east. A short distance from the shaft west, a rise has been made 30 feet, and "holed" through to the shaft for air, this rise, etc., is in ore.

East of the shaft is only a drift 15 feet in length, all in ore, not clean ore, some rock is mixed with it. It looks good enough to lead one to expect to find a body of ore in which the rock is left out.

No. 5 shaft is 300 feet west from No. 4, it is only about 30 feet deep, but it is in good ore and jasper. There is a good deal of clean ore in the shaft. Just now the shaft is idle. I think the diamond drill would be an economical machine to use in the exploring work at the Puritan; at No. 5 shaft and in the railroad cut west of it, especially. The railroad track cuts through the quartzite on the south side of the shafts, giving the proper elevation for loading cars, etc.

A new engine house has been built, and they are now placing in it a fine plant of machinery, consisting of steel boiler 60' x 16' besides heater, two winding drums, each 5' diameter; Ingersoll Air Compressor, to operate seven Rand drills. Engine house 48' x 25' with L 24' x 35'—iron roof.

The machinery was made at the Iron Bay Foundry, Marquette. Besides are change house 36' x 18', with wash room, etc., attached, large boarding house, fine residence for superintendent, and about 20 good miners' houses, etc.

For a new mine the Puritan is in good shape, and has a favorable outlook as a producer of first-class ore.

The yield in 1886 was 16,388 tons.

The officers are Geo. F. Jackson, President, Minneapolis; J. B. Collins, Secretary and Treasurer, Chicago, Ill.; H. M. Peck, Superintendent; B. M. Moyle, Mining Captain, Bessemer, Mich.

THE IRONTON IRON MINING CO.

As mentioned in describing the Puritan, the Iron-ton joins it on the east. The main opening, in fact the only point where ore is found, is adjacent to the Puritan. The Iron-ton looks well and the mine is in good hands. Captain Christopher, the General Manager, was for many years at the Michigamme mine, and is known in the Marquette range as a miner of more than ordinary skill.

The Iron-ton estate consists of 80 acres—a rectangle with the long dimension north and south, so that there is 80 rods in length of the ore formation—east and west.

From the west line the surface descends abruptly about 50 feet, where, more gradually, it inclines to the east margin, and thence on to the river, which courses through the valley to the north.

There is a shaft close to the east line, and they are mining against the west one; between these extremes are two or three shafts recently begun, but none very far advanced yet.

South of the line of the shafts, and about midway east and west, they have just completed a new engine house, which is supplied with four 5-foot drums, two engines, two boilers, each 48" x 16'.

The main ore deposit at the west end is 135 feet long and 70 feet wide. The shaft is at the east end of the deposit and is 100 feet deep, and in the foot wall. Hoisting is done in it with a skip. The plan pursued in mining this ore is to take it all out, letting the surface follow down, leaving an open pit above. Drifts are opened along both the hanging and foot walls, and timbered for passage ways, and the ore is cut out from the west end up to the filling, allowing the filling to follow down as the mining progresses towards the shaft. They work on top of the ore, carrying a cross stope under the filling and run the ore down the winze into shutes in the main drifts where it is let out into cars and trammed to the shaft. The ore is clean, first-class Bessemer, all of it.

East of the main deposit and separated from it by 55 feet of rock, is another lense of ore of harder quality—leaner. They have drifted in it 80 feet, but have not cross-cutted. Possibly the "bar" of rock will prove to be a capping, and that at lower depth the ore will be found to be all of one body.

At 225 feet east of the main shaft is No. 2, and they have just started

another one. It is close to the Wis. Central R. R. track, and will be No. 3—480 feet from No. 1.

No. 4 shaft is 185 feet west of the Tontine boundary and is now 94 feet deep. The Tontine found a small deposit of ore about 13 feet wide, and No. 4 shaft was sunk hoping to get this in greater magnitude in the Iron-ton side.

The company has 10,000 tons of ore in stock and hopes to mine this season 50,000.

The company shipped last season, 16,307 tons, which sold at an average price of \$5.00 per ton.

The officers are Samuel P. Snyder, President, Minneapolis, Minn.; A. J. Tremble, Secretary and Treasurer, Hurley, Wis.; J. P. Christopher, General Manager.

THE TONTINE MINE

joins the Iron-ton on the east. The main shaft is about 100 feet from the boundary, and is 130 feet deep. It is sinking to find the ore of which a small deposit was discovered in a shaft close to the line. The main shaft now sinking is vertical, and at bottom is 60 feet from the foot wall. They have just found the ore, but had not developed it as yet. They have a small engine house, with a limited plant of machinery, and several dwelling houses; also an ore dock convenient for stacking and shipping ore. The estate consists of 80 acres of land, being the E. $\frac{1}{2}$ of the S. E. $\frac{1}{4}$ of section 17.

The work is in charge of Capt. C. W. Hale.

THE VALLEY IRON MINING COMPANY

joins the Tontine. It is between the Tontine and the Colby. The land lies in the low ground, in the valley between the high bluffs in which are the Colby on the one hand and the Puritan on the other. The estate consists of 240 acres of land, being the S. $\frac{1}{2}$ N. W. $\frac{1}{4}$, N. $\frac{1}{2}$ S. W. $\frac{1}{4}$, N. $\frac{1}{2}$ S. E. $\frac{1}{4}$, Sec. 16.

They are working, mainly, not far west from the east line. A shaft was sunk and some lean ore obtained, some of which was shipped, and some is now in stock at the shaft. The shaft has been abandoned, at least for the present, and they are sinking another at about 300 feet further west and also north. A test pit was first sunk 45 feet, and good ore was found in it. They have a width of ore of 20 feet, and have drifted in it 30 feet northeast.

To mine this ore they are now sinking a shaft in the foot wall to the south of it, and 30 feet east of the test pit. The shaft is 40 feet deep. The drift will be connected with the stope for air. They have some good ore in stock, taken from this test pit. Have built a new engine house, contains two drums, each four foot diameter, Marinette make, boiler 48"x16'.

Further west on the line of the vein are several shafts. One is in the quartzite, another in ore and jasper. Recently a fire in the woods burnt up the plant at the shaft, and so no work was doing at the time of my visit. The mine is near Bessemer, has railroad facilities for shipping ore, etc. The product in 1886 was 1,842 tons. It is one of the Burton series of mines.

John E. Burton, President; J. G. Sherman, General Manager; Thomas Hawkins, Mining Captain.

THE COLBY MINE

is a phenomenon. It is a most extraordinary deposit of ore. It surpasses all the others in the Gogebic Range, in apparent magnitude, and then the situation is the most favorable for mining the ore cheaply. There is more ore in sight, more ore available, opened up, in readiness for stoping the present season, than can be seen in any other iron ore mine in the State.

The product will easily reach 300,000 tons the present season, and even exceed that amount if the company obtain sufficient facilities for shipping. No doubt the output will be greatly lessened through want of vessels. At the present writing, May 20, there are 90,000 tons in stock, and 50,000 tons have been sent away, and there are stopes enough in the mine to work all the shafts to their full capacity. One can stand on the surface at the west end, at the south deposit, and see in the open pit a stope of ore greater than he will often enjoy an opportunity of inspecting.

The mine is opened in two separate deposits of ore, situated north and south of each other, and running east and west. They are commonly spoken of as the north and the south veins. The south deposit is against the foot wall, the regular quartzite belt that underlies the ore in this portion of the range. The deposit has been opened for a length of 1,000 feet, and has a width of clean ore of 40 to 130 feet. The ore was first attacked at the west end, where the lenses outcropped just beneath the dirt, in the upper face of the bluff, where it descends somewhat abruptly to the west. The formation dips north at an angle of 65° , and the ore inclines also to the east at an angle of about 30° . As the work advanced eastward, the inclination of the ore has carried it under the rock capping, which, for a considerable distance, has been removed, but now this work of "stripping" the ore will cease, and the mining will be wholly underground, as it already mainly is.

The skip roads for hoisting the ore are laid on the foot wall, and the ascent to the south, except one, which follows the pitch of the ore down to the east. There are four of these hoisting avenues in the south deposit, designated as Nos. 1, 2, 3 and 4, the first two being in the open pit at the west end; 3 and 4 are regular shafts, and are wholly underground from the surface.

No. 1 runs up from the bottom of the open pit to the west. No. 2 ascends on the foot wall at the east end of the open pit. Its length is 130 feet. The two hoist about 300 tons daily. No 3 is 300 feet east of No. 2, and No. 4 600 feet from same point, and the openings extend 80 feet further east. Each shaft is 200 feet deep, and the levels are opened, in the two bottom ones of which, most of the ore is still in the mine. In the second level the ore averages 120 feet in width. In the bottom it is narrower, perhaps about 80 feet wide, the abridgment in width being caused by a chloritic dike on the north side, against the hanging wall, which dips south and so cuts out the ore. This dike is of soft material, seemingly a decomposed feldspathic rock.

I understand that since I was under ground in the mine they have cut through this dike and found the ore again north of it. No. 4 shaft is not yet provided with a track, but it is ready for one. Just now the company can hoist more ore than can be taken care of from the other shafts. The stock ground is all filled, and but few cars are furnished for shipping away. The ore is run to the edge of the bluff on the west, where are the ore pockets and the stock ground, and at suitable distance below it the tracks of the M. L. S. & W. R. R. Co. The Wisconsin Central railroad company has ascended to the top of the hill with its branch for the Colby, and built a track along on the foot wall, just south of the shafts, so that the ore will be dumped from the skips directly into the pocket. It will add greatly to the convenience and economy in handling ore. The ore is run from No. 3 to the pockets, etc., west, on a gravity incline, similar to that used at the Hematite shaft in the Lake Superior mine, which is fully described in the report of last year.

The method of mining contemplates taking out all the ore. The main drifts are east and west along the walls and at suitable distances through the deposit. Thence the ore is blocked out—rooms and pillars—each 40 feet. The rooms are timbered, using the usual sets, which are lagged up against the pillars. To remove the pillars the rooms are filled up with rock; that is, the surface material is run down and made to occupy the opened space; after which the pillars are mined away by taking successive stopes on top of them, under the dirt. This final work of exhausting the levels will proceed from one to the other working down, and thus the same filling material will serve from one to the other; as each is worked out the refuse dirt will be let down into the next below, and so on in succession. This plan of extracting the ore is a great advance on the method of endeavoring to hold the mine up with timbers. It is economical, expeditious and safe. Of course it requires mining experience, skill and great care; but it is undoubtedly the cheapest way to mine this ore.

The ore is very dry; it is a dry mine, and thus the pillars stand well. The

ore is easily mined, requires but little blasting. There is no more pleasant, comfortable mine to work in in the country than the Colby.

It costs to "run the drifts," which are 12' x 15' section, \$1.50 to \$2.50 per foot. They are made thus large for the timbers. The deposit is so large that when well opened there are an abundance of places to stope.

The north deposit, though not so large, has many interesting features. Measured on the surface it is 300 feet north of the south lense, but at the bottom they are now at less than 100 feet apart.

When I was at the mine in August of last year, the ore in the bottom of this open cut mine was exhausted; things looked a little blue. A dyke of "soap rock" had taken the place of the ore, and everywhere was rock. The dyke dipped to the south across the formation and thus cut off the ore. The indications favored the supposition that the ore would be found again in the foot wall, that the dyke had carried the ore south. The subsequent work has proved the correctness of this theory. The north mine is now all underground, away south of the open cut, and is constantly approaching the south deposit. Probably it will extend beneath it finally, or rather I incline to the supposition that the two will ultimately constitute one and the same deposit. At least that there will be no separation other than, may be, the chlorite, which is just now found on the north side of the ore in the south deposit. The ore in the north deposit varies somewhat from that in the south; it is harder, more banded, less homogeneous than the other. There are to be seen in the stopes in places bunches or wide seams of ferruginous schist that look in section like the ore; it is not easy to tell this rock from the ore without close inspection.

The dike on the north side really makes the foot wall in this deposit. It lies pretty flat and they work from it, allowing the overlying burden to fall on it. Standing on the north side of the open pit and looking south we see this south wall constantly crushing down. As the ore is removed it is made to settle down on the dike. The underground opening made in the north deposit is 400 feet long and 80 feet wide. It is reached by two shafts, one on the north side inclining downward to the south, following down on the face of the dike, and the other away over to the south, near the office, in what was thought, when it was sunk, to be the foot wall of the ore. But now the bottom of this shaft is near the dike, and the ore is away south of it. It is an easy mine to work; not much timbering is required; they worked south and let the roof crush in the dike.

All the surface appointments are simple. The machinery is such as is adequate to this work, but nothing superfluous. The mine is held on a limited lease, from the owners, by Pickands, Mather & Co., Cleveland, and the entire direction of the work is under Mr. Jos. Sellwood, of Ishpeming, who has a full

corps of competent assistants, prominent among whom is Capt. Harry Roberts, who is full of enthusiasm for the Colby. The company's lease runs until Nov., 1888.

The estate consists of two quarter sections—320 acres—in sections 16 and 15, 47, 46. The mine is, mainly, in section 16, though the extreme east end is in 15.

At a quarter of a mile further east the company has sunk a shaft, recently, 100 feet deep on the quartzite foot wall and have a deposit of clean ore in the bottom 70 feet wide, and they have drifted east and west in it 180 feet.

An engine house has been built and is supplied with new machinery adequate to operate the mine. It does not seem likely that work here will be pushed greatly, since it will be difficult to ship the ore.

The situation at the Colby mine is a remarkably pleasant one. The location within the limits of the rapidly growing village of Bessemer, the seat of the new county of Gogebic, and is at an elevation of about 200 feet above the railroad. At the depot from the mine an extensive prospect is spread out to the north in the direction of Lake Superior, which is varied and beautiful. There were shipped from the mine in 1885, 84,312 tons of ore. In 1886, 257,433 tons; total, 341,745 tons.

The ore averages about 62% in iron and .040% in phosphorus; like all the Gogebic ores it is low in silica, some of it especially, along the walls, is black manganese ore.

THE PALMS IRON MINING COMPANY

holds on a lease from the Palms estate the N. W. $\frac{1}{4}$ of Sec. 14, east of the Colby. The Palms is a well arranged mine, so far as the surface plans determine the matter. The ground is elevated, one of the highest locations in the range, and the shafts are in line, sunk on the foot wall.

A new railroad track has just been laid along the foot wall side of the shafts, convenient for the pockets for receiving and transferring the ore directly from the skips. Away down the slope of the hill to the north is the track earlier located, where is an ore dock 300 feet long, and ore pockets, the latter 40 feet high. A tram track 700 feet long extends from the east part of the mine to this ore dock; but now that the railroad company (M. L. S. & W.) has built along close to the shafts, it is not likely that the one down under the hill to the north will be greatly used.

The shafts are well distributed, but thus far they do not seem to have penetrated any large body of ore. They are mainly in a mixed ore formation. More or less rock is found in connection with the ore. This is true of all the shafts, but none of them is very deep yet, and judging from the experience

recently acquired at the Anvil, which is the next mine on the east, better results are likely to be obtained at a greater depth.

No. 4 shaft is 700 feet east of the west line, and is 50 feet deep, all the way in ore. They struck ore in a test pit 22 feet west of the shaft, and drifted south in it to the quartzite. It is very good ore, and is thus a promising opening.

No. 3 is 300 feet east of it, and 78 feet deep. After passing through 17 feet of surface, the shaft came into ore in which it still continues, but it is not very wide. Possibly it will open out deeper down.

No. 1 is 300 feet east of No. 3, and is 130 feet deep; 18 feet of surface, thence on, ore until within 10 feet of bottom, when the rock appears in such quantity as to render the ore valueless.

A cross-cut was driven 78 feet north at the depth of 100 feet, which cut 12 feet mixed ore, 10 feet good ore, then nine feet mixed, six feet good, and so on alternating to the end of the drift. In this shaft they have also drifted east 80 feet, 60 feet of which is pretty good ore. The last 20 feet mainly rock. West of the shaft for 50 feet the drift is through ore, but ends in rock.

No. 2 shaft is 118 feet deep, and is 200 feet east of No. 1. The 100-foot level has been driven west 110 feet, one-fourth of which distance is in rock, thence 30 feet is in ore; the remainder of the distance is in mixed ore and rock. The 50-foot level has been driven east 25 feet, all the way in ore, but they have not tested its width.

There is a commodious engine house, holding two drums, each 4' diameter, for Nos. 1 and 2 shafts, Mariette make, two boilers, etc. The other shafts have smaller, separate hoists. There is room in the engine house for two more drums, which will soon be supplied, of a larger pattern than the others. The force of men employed consists of about 75. The company has a fine boarding house, and other essential buildings, including office, dwellings, etc.

The royalty on the ore which the company agrees to pay is 75 cents per ton.

Among the officers are F. Rockhauser, President, Milwaukee, Wisconsin; General Manager, John A. Hayward, Bessemer, Michigan; John Hoskins, Mining Captain, Bessemer, Michigan.

THE ANVIL IRON MINING CO.

holds the quarter section next east of the Palms—the N. E. $\frac{1}{4}$ of Sec. 14. From the shafts the ground descends steeply to the north to the railroad, and also on the east side begins its descent in the direction of the Black river, which lies 200 feet below the surface at the mine.

The Anvil is a new mine; as to that matter all the mines in the Gogebic may be called new, but the Anvil is a newer development than some others. It has

come into prominence quite recently through the discovery that the main ore body is of very large proportions, a matter that has just been ascertained. So that now it is quite certain that the Anvil, for a time at least, is to be a large producer.

The parties who control the property now came into possession of it last November, and it is since then that most of the mining work has been done; certainly all that which has led to the late fortunate discovery of ore.

The mine is not yet equipped with machinery except to a very limited degree; a few cheap buildings, small engines, twenty-inch drums, with hemp ropes, constitute the outfit. But it is not to be supposed that this state of things will long continue. Steps have been taken to provide all that is requisite to pursue extensive operations.

The railroad company—M., L. S. & W.—is prolonging the Palms branch east to create a like convenience at the Anvil.

There seems to have been considerable desultory exploring work done on the property, which did not avail much, and I shall confine my description to those sinkings only which will be used as shafts.

No. 1 is 360 feet east of the west line, and 50 feet south from the east and west $\frac{1}{4}$ line and 175 feet deep. It opens into the ore, which gives the mine its chief value. It is in this shaft that the main attraction lies, the basis of the great good fortune that has come to the hands of the owners.

The results in this shaft are a valuable experience; they suggest a similar good fortune to others, and stimulate to perseverance and continued effort where, seemingly, like conditions are found. There are those exploring diligently who, though they have nothing of much value, as yet, are still led by the hope of a final outcome of good luck, parallel with that reached at the Anvil.

To particularize in regard to No. 1 shaft, when the ore was first found, it was but four feet in width, and at 75 feet in depth it proved to be 13 feet wide, but when the shaft had reached a depth of 175 feet, a cross-cut to the north was again started and pursued for a length of 180 feet, 161 feet of which distance is in ore. I examined this drift, somewhat hastily, and did not discover anything but ore. Some of it is clean fine ore, especially in the part adjacent to the foot wall, but there are other portions, towards the north, in the north half or the drift, where the ore is mixed with sand. Still, the whole drift for the length of 161 feet seems to be all ore; assuredly a wide body of it. The rock is at the north end of the drift, 19 feet of mixed rock and ore.

Samples of the ore for an average of the first 45 feet from the shaft, gave an analysis 64.80% metallic iron. The succeeding 35 feet of length gave 62.20%. The following portion of drift for 45 feet, 61.80%. Average for 130 feet of

the drift was 61.80% in iron, .028 in phosphorus. The final 33 feet of the ore averaged 56 % in iron, .031% phosphorus. These figures were given me by Mr. Scott.

At a point 60 feet from the foot wall a drift has been made in the ore west, 55 feet long. It is all in good ore. A winze is sinking at the end of this drift, with the view of securing circulation of air in the level below when it shall be opened.

A drift has been opened east along the foot wall 130 feet, all in ore. The end is under the air shaft, which is 120 feet deep. When sunk to the drift it will insure circulation to the east part of the mine. West, on the foot wall, have gone 80 feet, also, all in ore; are still drifting. The opening work has been limited to the power of the machinery. The new machinery for this shaft, and for No. 2, with compressor, two 5-foot Merritt drums, engine 125 horse power, and two steel boilers, 80-horse power each. There is one 45-horse power boiler on hand now, one 36" Rochester hoist, 3 Camerom pumps, No. 7.

No 2 shaft is 560 feet east of No. 1, and is on the hanging wall side of the ore. It is 110 feet deep, but is not worked in now.

No. 3 is 840 feet east of No. 2, and is 160 feet deep, all in ore, except the 10 feet of soil first penetrated. It is sunk on the quartzite, having been commenced early in the winter.

At the bottom there is a drift east 163 feet, all the way in ore. At 30 feet from the shaft the ore proves to be 15 feet wide, and at 70 feet 17 feet in width.

The company employs about 50 men. A larger force cannot be used to advantage until the new machinery is ready, and the track is built along the foot wall.

There is a little ore in stock, taken from the openings, mainly in No. 1, which will be sent down the hill to the north on the ore tract, etc.

South of the mine is a level table land, on which the company designs to lay out a location for miners' houses, etc.

Some provision must be made for water. There is none on the surface, and the mine affords but little.

The officers are G. E. Tarbell, President, Milwaukee; F. H. Smith, Secretary, Milwaukee; W. B. Scott, General Manager; George Green, Mining Captain.

The same gentlemen have lately secured the control of 80 acres joining on the east, to wit: the W. $\frac{1}{2}$ N. W. $\frac{1}{4}$, Section 13, and designate it as

THE EAST ANVIL.

They are sinking a shaft on the foot wall near the west line, near the corner between the two forties. It is 55 feet deep in mixed ore and rock. Other parties have explored on this property for a year past. Several shafts have been sunk, but all of them north of the foot wall, and further down the hill. Nothing of value was discovered.

The present work is in charge of Capt. John Humble.

THE GOGEBIC MINE

is the next 80 east, the steep side hill that extends to the Black river. On this property is also the village of Hubbardsville, where is an hotel, postoffice, etc., and down at the river a saw mill. There are a good many test pits on the property, but no ore has been found.

Some parties are exploring in the W. $\frac{1}{2}$ S. E. $\frac{1}{4}$, Sec. 11, which joins the Anvil on the north. It is called the

NORTH ANVIL,

and lies in the Sunday Lake range west. Whatever it holds of value remains to be found.

Crossing the main branch of the Black river at the Gogebic, we reach, on the east side,

THE WELLS AND MINER OPTION,

so called, being the N. E. $\frac{1}{4}$ of Sec. 13. The exploring work in this property is mainly in the E. $\frac{1}{2}$ near the center south of the railroad and by the east branch of the river. The two branches of the river form a junction near the N. $\frac{1}{4}$ post of Sec. 13 and the east branch extends west and northwest to Sunday Lake, of which it is the outlet.

I noticed chiefly 3 shafts; one about 20 rods from the $\frac{1}{2}$ line on the north side: it is 60 feet deep and is not worked in now.

No. 1 is the north shaft, 110 ft. deep. It has passed through a variety of rocks and is now in a quartzitic flag, above which the shaft cut through jasper. At a depth of 100 ft. from the surface a cross-cut was driven north 164 ft. through jasper, soap rock and poor ore.

No. 2 is 130 ft. deep, have a drift south, 80 ft. at 110 ft. down. From the drift 68 ft. from the shaft, drove west 38 ft. and at 25 ft. from shaft drove north 40 ft. All the rock is broken, partially decomposed, jasper, chlorite, lean ore, etc.

They are still working in the north drift in No. 2 shaft, following a small "leader of ore," hoping it will make into a body of ore. The river is about 40 feet below No. 1. I think I would sink deeper and drift north. The two shafts in which they are working are provided with machines for hoisting and pumping.

Frank D. Koob has charge of the work, and is assisted by about 30 men. They have been at work for 12 months, but have met with results scarcely equal to their efforts and hopes.

Joining this property on the east is

THE RHINELANDER,

being the W. $\frac{1}{2}$ N. W. $\frac{1}{4}$ Sec. 18, T. 47, R. 45. The river crosses diagonally through the land, and the company has explored on both sides of the stream where it cuts through the ore formation. The main shaft, the only point at which work is now prosecuted, is in the west margin of the river, starting in the bank 20 feet above the water. This shaft is near the west line, and near the center of it. The shaft was sunk 30 feet, and then left, and the work pushed further north, on the west side of the stream; but as nothing favorable was found there, the work has been concentrated since February last, in the shaft first mentioned. It is now, May 27, 105 feet deep and still sinking. It is in ore, not first class ore, but good lean ore. I was told that it gave 57% in iron and .041% phosphorus, as an average analysis. At 85 feet down they started a cross-cut, which is now 17 feet in north, and is all the way in ore.

I believe the company is incorporated.

David H. Martin resides at the mine and superintends the work.

The next mine east of the latter is

THE MIKADO,

being the E. $\frac{1}{2}$ of the N. W. of Sec. 18.

At the time of my visit I thought that the Mikado looked quite encouraging. They were working in two shafts, which are located about 250 feet apart, north and south of each other. The railroad runs across the south part of the property, and the ground from the railroad north has been tested pretty freely at about the center of the land where they are now working.

The shafts are both 85 feet deep, and each is partially in ore. Some pretty good ore is taken from the bottom of each shaft, so that one is justified in thinking that possibly at greater depth there will be found a good body of clean ore. All the way down the shafts cut lean ore and jasper, and in the south shaft some chlorite.

At the Rhinelander, north of the ore, in the river bank, is an out crop of diorite, and I think it will also be found in the hanging wall at the Mikado and others of these mines.

There is a small hoisting plant and pump at the south shaft, and there is a boarding house, camp, for the men. The work is prosecuted under the direction of Capt. Harry Letcher.

Jay A. Hubbell, President, Houghton; Mat. Van Orden, Secretary and Treasurer.

Joining the Mikado on the east is the

ATWOOD OPTION,

the N. W. $\frac{1}{4}$ N. E. $\frac{1}{4}$, Sec. 18. In this forty, near the southwest corner, is a shaft about 30 feet deep, where I found in the material raised in sinking, a plentiful sprinkling of good ore. As they had no pump they were forced to stop sinking on account of the water. The ground is a little low and wet. They were sinking another shaft a few hundred feet northeast of the former, using windlass and bucket. It was, when I saw it, 40 feet down, and the south half of it in ore, good brown hematite.

Mr. James Atwood is superintending the work, and, I think, controls matters pertaining to it.

THE PILGRIM

estate consists of 120 acres, being the E. $\frac{1}{2}$ and the S. W. $\frac{1}{4}$ of the N. E. $\frac{1}{4}$ S. 18. It is controlled by the same gentlemen who hold the Mikado, and Capt. Letcher is superintending the work. He has tested north and south across the formation by means of shallow diamond drill borings and finally located a shaft, which is now rapidly sinking at the point where he judged the best results would be obtained. The shaft inclines to the north 60° . A small engine house has been built and holds a 36 " drum, wire rope etc. for the work of sinking. The shaft is about 65 ft. deep, but no ore of any amount has been found yet.

THE SPEEDWELL

is across the river east of the Pilgrim—the W. $\frac{1}{2}$ of the N. W. $\frac{1}{4}$ Sec 17. Capt. Letcher is in charge of the work and is boring with a diamond drill. The indications are favorable but the ore is yet to reward the sinking.

The adjoining 80, which is the complement of the preceding in this quarter section—to wit, the east half of the N. W. $\frac{1}{4}$ of 17—is called

THE STAR,

where they are also exploring with a diamond drill.

THE FLORENCE

is the next property—the W. $\frac{1}{2}$ of the N. E. $\frac{1}{4}$ Sec. 17. The Florence and the Star have joined their forces and are boring with a diamond drill on the line between the properties.

They sunk the sand pipe through 80 ft. of sand, etc. to reach the ledge in which the drill is now working. Capt. Letcher superintends the work.

I saw a drill also boring in the W. $\frac{1}{2}$ of Sec. 16—not far from the depot in the village of Wakefield. They all find a little ore and good indications.

THE SUNDAY LAKE RANGE

extends through the next line of sections north of the preceding. The chief mines are in sections 7, 8, 9 and 10, T. 47, R. 45.

The three most easterly ones—Brotherton, Sunday Lake and Iron Chief being ore producers. None of the others has ore in quantity and purity sufficient to make it a shipper in a commercial sense.

The most easterly mine in the Gogebic range which is producing ore is

THE IRON CHIEF,

operated by Moore, Benjamin & Co. The description is the E. $\frac{1}{2}$ S. W. Sec. 10, T. 47, R. 45, being $\frac{3}{4}$ of a mile east of Sunday Lake. The company reported having mined and shipped in 1886 9,500 tons of ore which sold at an average price of \$5.50 per ton, which facts indicate favorably for a new development.

The mine workings are reached through two shafts that are but 40 ft. apart, and the east one of which is only to the 1st level 65 ft. below the surface. No. 2 shaft, the east one, is downright, while No. 1 inclines to the north. It is located 100 ft. east from the west line of the property and is 170 ft. deep on the lay. The bottom of the shaft is in ore, 10 ft. wide and they have drifted east 100 ft. in it. No cross-cutting has been done in the bottom but in the 1st level is a drift north 141 ft. and one south 90 ft., neither of them in ore. It is contemplated to procure heavier machinery for No. 1 shaft.

H. M. Benjamin, Prest., Milwaukee; Ric'd A. Parker, Gen'l Manager, Hurley, Wis.; D. McVichie, Supt., Wakefield, Mich.

SUNDAY LAKE MINE

lies upon the side hill northeast from Sunday lake, being the W. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$, Sec. 10, and is one of the early and well known mines of the range. The mine has two working shafts, the west one of which is but 80 feet east of the west line of the land of the company. It is 150 feet deep and has been, since reaching the ledge, all the way in ore. At the bottom the ore east is about 10

feet wide, and so continues west of the shaft for a distance of 30 feet, thence west for 50 feet, to the line, it is 40 feet in width; but it is not clean ore, very much of it, especially on the north side of the deposit, is rock or ore in which there is so great a proportion of sand rock boulders as to render the ore of not much practical value. East, the shafts are connected 187 feet apart, and they were making at the bottom when I was last down in the mine a secure timber drift between the shafts.

No. 2 is 200 feet deep, and the ore extends east 100 feet. It is 18 feet in width, and is cleaner than the ore in No. 1 shaft. The shaft is downright, having started in the hanging wall, but has cut through the overlying rock and the ore, and is now in the foot.

The ore has been run from the shafts out on elevated tracks to the stock pile at the foot of the hill, where is the railroad track; but they are now building a track along on the foot wall side of the shafts, so that the matter of surface tramming of the ore will be saved in future. The company has a small stock pile of very nice ore.

The engine house situated south of the shafts is supplied with two drums each four feet diameter.

This is also one of the mines operated by Moore, Benjamin & Co., and has the same officers as those given in the preceding page for the Iron Chief.

THE BROTHERTON MINING CO.

holds the north half of the S. E. $\frac{1}{4}$, Sec. 9, lying next west of the Sunday Lake mine. As the rectangle lies the long way east and west, the company possesses a full half mile in length of the ore formation. The lake takes a portion of the land in the southwest corner. Until recently the east end of the mine has not been much worked, but now they are concentrating the work in Nos. 2 and 3 shafts, the latter of which is the most easterly, being 180 feet west of the east line. It is 100 feet deep, and they have drifted east 170 feet in first level, and west 100 feet. They will open into the Sunday Lake mine and stope back the ore, which is 15 feet wide to the shaft. In the second level they have driven east 100 feet, but none west. Previous to February last this shaft was only a test pit. They find the indications so good that the hope is entertained that the shaft will prove a good producer of ore. They have not cross-cutted much as yet. The shaft is in high ground at least 50 feet above No. 2, which is in the swamp, or what was originally Cedar swamp. The daily product is now, May 25, about 60 tons.

No. 2 is, as above stated, in low ground 500 feet west of No. 3, and is 100 feet in depth. It is sunk in rock, in what is supposed to be a separation be-

tween the two branches into which the ore body at No. 1 divides in going east.

Work in this shaft, as well as in No. 1, was seriously impeded in the spring when the snow melted, by reason of the pits being flooded with water.

At the time of my recent visit to the mine they were erecting the frame for a shaft house at No. 2, and an elevated tram road 100 feet long from the shaft south to the railroad where will also be an ore pocket.

In this shaft are two cross-cuts, one 25 feet north and the other south 12 feet. The ore "makes" north in the south deposit and south in the north one, so that they may come together, in which case Capt. Bowden, a former copper miner, entertains the opinion that at the union will be found a large deposit of ore.

The ore obtained at the Brotherton has been mined, chiefly, in No. 1 shaft, 500 feet west of No. 2, with which it is connected by drift in the first level. The workings also reach west, 300 feet from the shaft, making the total length underground in the first level 800 feet. The ore was of variable width, reaching a maximum of 40 feet. The shaft is sunk to the second level. I did not go underground in No. 1 shaft, but inferred from what was told me that the mine did not have a hopeful look in the bottom of this shaft. There were about 14,000 tons of excellent ore in stock, and it was stated that the product for the season would reach 50,000 tons.

No. 1 and 2 shafts are operated by the machinery in the main engine house, consisting of boiler, two Merritt drums, each five feet diameter. No. 3 has a separate plant near the shaft.

There were shipped from the mine in 1886, 8,880 tons of ore.

Jos. Sellwood, General Manager, Bessemer, Mich.; Richard Bowden, Supt.

THE CROWN POINT MINING CO.

holds the S. W. $\frac{1}{4}$ of Sec. 9, all of which, except a narrow strip along the north side, is covered by Sunday Lake.

The company has been exploring here about 14 months and has now 18 men and at the time of my visit was getting in a new boiler to secure an increased amount of steam for pumps, etc. The main shaft is 30 rods east of the west line, near the margin of the lake, and is 140 ft. deep. At 64 ft. down is a cross-cut 34 ft. and at 110 ft. from surface is another drift north 28 ft. They found seams of ore and jasper; not enough ore to mine. Intend to sink deeper and cross-cut more.

The work is in charge of Thomas Cavender, who resides on the land.

THE CHICAGO MINING CO.

is exploring on the E. $\frac{1}{2}$ S. E. $\frac{1}{4}$, Sec. 8; joining the Crown Point on the west.

Considerable work has been done. The company has a shaft 300 ft. from the line 87 ft. deep, vertical, and has a small deposit of good ore. There are about 20 tons in stock, merchantable ore. There are other shafts and pits, but none showing ore. Joseph Lee, Supt. Work 12 men, have suitable plant of machinery.

THE HOUGHTON,

formerly the Jumbo, is the W. $\frac{1}{2}$ S. E. $\frac{1}{4}$, Sec. 8; has sunk several shafts, but found no ore; the one in which they were working when I inspected the location is 96 ft. deep. They were cutting through jasper with seams of good ore. Near the shaft is a hoisting plant, boiler, etc. The other shafts were in rock—one in quartzite. Capt. John Cruse superintends the work.

THE ALPHA MINING CO.

holds the S. W. $\frac{1}{4}$ of the N. E. $\frac{1}{4}$ and the N. W. $\frac{1}{4}$, Sec. 9.

The work is under the direction of John Sparling. He is sinking No. 1 shaft 224 ft. north of the south line and 100 ft. east of west line and is down 135 ft. And 400 ft. further east is No. 2 shaft, 60 ft. deep. They found some ore with the jasper cut in the shafts, which they pick and save.

No. 2 contains the most ore as it was found right under the sand, not quite clean but pretty good. When greater depth is attained they will cross-cut.

Frank V. Holston, Prest., Ashland.

THE IRONSIDES.

is the E. $\frac{1}{2}$ S. W. $\frac{1}{4}$, Sec. 8. Joins the Houghton on the west. The main shaft is 200 ft. south of the north line and is 105 ft. deep in mixed ore and rock.

At 100 ft. down is a drift south 48 ft., also in jasper and mixed ore. They have no body of clean ore. There is another shaft 70 ft. deep.

N. M. Stowell, Prest., Milwaukee; Ralph Wilcox, Supt., Wakefield, Mich.

THE NORWAY MINING CO.

holds the W. $\frac{1}{2}$ of the S. W. $\frac{1}{4}$ of Sec. 8—next west from the Ironsides. The Co. is sinking in a shaft that is 80 ft. deep in mixed ore and rock. Good indications; looks as if ore would be found.

West of the Norway, in the E. $\frac{1}{2}$ S. E. $\frac{1}{4}$ Sec. 7, is

THE IRON PRINCE,

which is one of the most prominent locations in this portion of the Sunday Lake range. But with this, as with the others, the ore in quantity sufficient to

mine is yet to be discovered. Work began here on the 2d of January last and has been continuously prosecuted since. Omitting any mention of the earlier pits, I found one shaft 72 ft. deep and in it a cross-cut north 28 ft., through mixed ore and rock. Also at 60 ft. down they have drifted east 26 ft. on top of a lense of ore. Same mixed stuff as found in cross-cut. They will sink 50 ft. more and again cross-cut, etc.

J. M. Stowell, Prest., Ralph Wilcox, Supt.

But it is useless to multiply descriptions. These new explorations nearly all show pretty good indications, but none of them shows any considerable body of ore. No doubt it is a little discouraging, as most of them anticipated better results ere this.

East from Sunday Lake for a distance of 16 miles, all the way to lake Gogebic, is almost a continuous line of exploring camps. On nearly every section, every 80 in towns 47, R. 43, and 47, 42, in the line of the ore formation is a mining location.

Among those which I visited are

THE HOLYOKE,

in the S. $\frac{1}{2}$ S. W. $\frac{1}{4}$ Sec. 18, 47, 42.

Messrs. Wright and Wakefield, in the N. E. $\frac{1}{4}$ Sec. 20 and the N. W. Sec. 21, near Gogebic Lake. They have a number of men working and have several pits down in the ledge. The same parties have also the

THE IRON AGE MINING CO.

and are working in the N. $\frac{1}{2}$ N. E. $\frac{1}{4}$, Sec. 24, 47, 43.

THE DICKIE,

E. $\frac{1}{2}$ N. E. $\frac{1}{4}$, Sec. 47, 42.

THE CHICAGO,

W. $\frac{1}{2}$ E. $\frac{1}{2}$, Sec. 23, 47, 43.

AT CHANNINGS,

in the N. E. $\frac{1}{4}$, Sec. 23, 47, 43, is a large camp, that has several good buildings, etc., and the men are busy digging in search of ore.

But is unnecessary to mention them all. They have a good deal of faith as yet, but to keep it up some one must find ore after a while, or they will become discouraged. The formation is not unfavorable for the occurrence of ore.

By far the best explorations are north of Marinessco, in the vicinity of the east branch of the Presque Isle river. These are the JOLIET, LA RUE,

PRESQUE ISLE, ARTHUR, LOGAN, HOLLAND and LINCOLN. The locality is known as the

TOBIN RANGE,

through the fact that Capt. James Tobin, a well known explorer, has conducted several of the above mentioned explorations. He has also, recently, in expectation of the final success of the exploratory work, platted a "town site," to be known as TOBIN.

THE JOLIET

is in the N. $\frac{1}{2}$ N. E. $\frac{1}{4}$, Sec. 22, and the

LA RUE

is in the W. $\frac{1}{2}$ N. W. $\frac{1}{4}$ of the same section.

THE PRESQUE ISLE

is in the S. $\frac{1}{2}$ N. E. $\frac{1}{4}$, Sec. 21, T. 47, R. 43, and is rated as one of the most valuable properties in the Tobin Range. Just now it is eclipsed by the explorations on the opposite side of the river, to wit: at

THE HOLLAND,

and others. The Holland is in the N. $\frac{1}{2}$ S. E. $\frac{1}{4}$, Sec. 20, T. 47, R. 43, where is a shaft 91 feet deep, which has cut through banded red slate very much contorted. They found in the shaft, at 80 feet down, some clean ore, very nice ore, which analyzed 63% in iron, and .029% phosphorus. This ore "cut out," and the shaft is now in mixed rock and ore. The ore is black, soft hematite.

THE ARTHUR

is in the same section, west of the Holland, where good ore is also to be seen. It differs from the other, however, being a slate ore, not hard, but firm in texture. It is found at only 11 feet from the surface. Just how much of it may exist is not determined.

THE LOGAN

joins the Arthur on the west, also in Sec. 20. I found them sinking in a shaft which was 40 feet deep. It is 14 feet to the ledge, after reaching which the shaft cut through rock with indications of ore. I saw some large pieces of first-class hard ore, found in the bottom of the shaft. The shaft is now in mixed ore and rock, gray siliceous flag and jasper.

THE APPLETON

is the name given to an exploration southeast of Marinesco, in what is called the Magnetic Range, in township 46 N., R. 42 W. There are strong magnetic attractions, and specimens of good magnetic ore found in this locality.

Considerable exploring has been done by different parties during the past two years. Mr. J. Lowenthal and others of Appleton, Wis., are operating now on the N. W. $\frac{1}{4}$ N. W. $\frac{1}{4}$, Sec. 13, and S. W. $\frac{1}{4}$ of the S. W. $\frac{1}{4}$ of Sec. 12. Mr. F. A. Wright is boring with a diamond drill for these gentlemen and seems to be approaching good results. At the time of my visit, about the first of June, he had a core of seven feet of ore, first-class magnetic ore. Heretofore the deposits have all appeared to be too small to be of value.

THE REPUBLIC REDUCTION COMPANY

is the title to an enterprise at Republic, controlled by Peter Gottstein and S. D. North, of Hancock, Michigan. The plan is to extract by crushing and washing, the ore contained in the waste rock of the Republic mine.

They have a suitable building and steam power. They are experimenting now with a Sturtevant mill, No. 12, 1,200 revolutions per minute. They are using No. 12 wire mash, and finishing on No. 30. They run through 38 tons of rock in 7 hours, and get 55% of ore from the rock; that is, they waste 45%. There is practically an inexhaustible supply of the rock. No doubt the concern will ultimately be successful. The ore is Bessemer, and is, when reduced, in proper condition for a "fix."

PIG IRON.

DESCRIPTION OF BLAST FURNACES.

SPRING LAKE IRON CO.

owns and operates a furnace at Spring Lake, in Muskegon Co., Mich. The furnace is in many respects extremely favorably situated for economical work, and the record of the furnace since it first went into blast has been exceptionally good.

The furnace is placed near the dock, so that the ore is unloaded directly from the vessels into the stock house. Other material is loaded and unloaded into and from vessels with the greatest facility. Railroad advantages are all that can be desired. The furnace stack is 46 feet in height; diameter of bosh 10' 8".

The wood used for charcoal is 75% hard and 25% soft wood. The bushel is 2,748 cubic inches, and weighs, when suitably dry, 20 pounds. Use Kelly Island limestone. The ores used in past year were Lake Angeline mine, 10,000 tons; Ludington non-Bessemer, 10,000 tons, also Great Western and the Cleveland mine, No. 1, hard ore; used of the hard ore 25%.

The ores used in 1885 were 25% and 50%, respectively, of Lake Superior mine No. 1 specular and hematite, and 25% of Milwaukee mine ore. The following table shows the comparative record of the two years' work:

Record of Fruitport Furnace.	1885.	1886.
Bushels of charcoal used.....	1,444,675	1,610,850
Gross tons of ore used.....	28,684	29,551
Gross tons of limestone used.....	386	431
Number of tons of pig-iron made.....	17,217	17,776
PARTICULARS.		
Number of charges run.....	57,787	64,434
Number of bushels per ton of iron made.....	84	90½
Per cent of yield of ore in the furnace.....	60¾	60
Number of pounds of limestone used per ton of iron.....	50	54¾
Number of days run.....	321	324
Average daily product.....	53.63	54.85

The temperature of the blast was made less in the past year than heretofore, being reduced to about 800° Fahrenheit.

The company contemplates building a second stack. It has also lately leased the Bangor furnace and will run it in 1887.

J. C Ford, Supt.; Robert Lomeraux, founder.

THE ELK RAPIDS IRON COMPANY.

It would be difficult to locate a furnace more favorably with respect to obtaining wood for charcoal, and for shipping by water. The height of the stack is 47 feet, and diameter of bosh $11\frac{1}{2}$ feet. In 1885 the furnace made, on the average for the year, 304 days, 53 tons of iron per day, using 93 bushels of charcoal per ton. The following table shows the results for the year 1886, just closed:

Total No. of tons of pig iron made.....	17,434 $\frac{9.00}{2240}$
Total No of tons of ore used.....	29,801 $\frac{9.00}{2240}$
Per cent of yield of ore in the furnace, <i>i. e.</i> , No. of lbs. of iron to each 100 lbs of ore used	58.70
Total No. of tons of limestone used.....	925 $\frac{6.10}{2240}$
Total No. of bushels of charcoal used.....	1,715,905
Average No. of bushels of charcoal to ton of iron made	98.42
Total No. of days that the furnace was in blast	309
Average number of tons of of pig iron made per day run.....	56 $\frac{9.45}{2240}$
Market value of pig iron made.....	\$338,728.67

The ores used were Cleveland and Barnum mines hard specular, Cleveland hematite, Jackson south side, Detroit, Great Western.

Edwin S. Noble, Secretary, Elk Rapids, Michigan.

MARTEL FURNACE COMPANY.

The Martel furnace is situated at St. Ignace, in the Upper Peninsula, on the Straits of Mackinac. It was built in 1881, on the completion of the railroad from St. Ignace to Marquette, but after being in blast for a brief time, it was closed down, and has since been idle, until the past year, when it was put into blast, and has been run 139 days. Height of stack, 53 feet; diameter of bosh, $10\frac{1}{2}$ feet.

No. of bushels of charcoal per ton of iron.....	84
No. of days run.....	139
Total No. of tons of pig iron made.....	7,666
Yield of ore in furnace.....	60%

Ores used, Lake Superior Iron Company's "A" shaft, Champion mine suffolk ore, Wetmore mine ore, and Milwaukee mine ore.

W. B. Vance, Secretary.

THE PIONEER FURNACE

at Negaunee, No. 2 stack, has been run as usual, but they were necessitated to stop for some time, so that a less amount of iron was made as a whole than usual. Product for 1886, 11,079 tons. The Pioneer has been run for 30 years.

Alex. Maitland, General Manager, Negaunee, Michigan.

THE GAYLORD IRON CO.

operates a furnace at the foot of Iron street in Detroit. The height of stack from bottom stories to cover of bell and hopper is 44 ft.

Diameter of bosh is $9\frac{1}{2}$ ft.

The furnace made in 1885 4,803 tons of iron, using $99\frac{3}{4}$ bushels of charcoal to the ton of iron. Charcoal weighs 20 lbs to the bushel. In 1886 the furnace made 8,903 tons of pig iron.

No of days furnace was in blast in 1886, 356 days.

No. of bushels charcoal used, 753,000.

No. tons of iron ore smelted, 13,235.

No. of bushels charcoal used per ton of iron made, $84\frac{1}{2}$.

All Lake Superior ores, yield of ore in the furnace, i. e., No. lbs. of iron made from each 100 lbs. of ore, 61%.

N. Woods, clerk, etc., Gaylord Iron Co., Detroit.

THE JACKSON IRON CO.

has operated one stack at Fayette, Delta Co., L. S., Mich., in which were made during the year 1886 10,581 $\frac{1}{2}$ tons of pig iron.

No. bushels of charcoal used, 1,122,840.

No. bushels of charcoal used per ton of iron made, $115\frac{1}{2}$.

Total No. of tons of limestone used was, 871.

Per cent. of yield of ore in furnace, 61.6%.

Average market value of the iron in Cleveland, \$17.59 per ton.

Height of stack 59 ft., diameter of bosh $9\frac{1}{2}$ ft. Ore used was Jackson mine-ore, hard and soft. The wood for charcoal was 50% soft wood.

H. S. Merry, Supt., Fayette, Mich.

EUREKA IRON AND STEEL WORKS

manufacture at Wyandotte, Mich.

The furnace is 56 ft. high with 11 ft. diameter of bosh.

The Co. made during 1886, of pig iron, 11,668 $\frac{1}{2}$ gross tons.

No. of days the furnace was in blast, 241.

No. of bushels charcoal consumed, 1,124,000.

No. of bushels charcoal consumed to the ton of iron made, $96\frac{1}{2}$.

Average yield of ore in furnace, 60%.

Iron sold from \$19 to \$24 per ton.

A great variety of ore was used, consisting of Michigamme, Barnum and Cleveland mine hard ores, Salisbury, Chapin, Norway, Detroit, Gt. Western hematites.

J. G. Van Alstyne, Agt.

DETROIT IRON FURNACE CO.

has a furnace in operation at Hamtramck Detroit, which is $50\frac{1}{2}$ ft. high, with $10\frac{1}{2}$ ft. diameter of bosh.

No. of days run in 1886, 181.

No. of tons of pig iron made, 7,641.

No. bushels charcoal used per ton of iron made, 95.

Yield of ore in furnace, L. S. ores, 59 6-7%.

Seven tuyeres each 3 in diameter.

Top at charging line 7 ft. diameter.

Closed top, Lee Burt's patent charging apparatus.

Hearth water jacketed.

Capacity of furnace 50 to 55 tons per day, according to richness of ore used. The No. of bushels charcoal used per ton of iron also varies from 85 to 95, according to the quality of the iron made, i. e., it requires more charcoal to make No. 1 and 2 iron than it does to make Nos. 3, 4, 5, etc. The Co. was organized in 1879. James McMillan, Prest.; Hugh McMillan, Treas. and V. P.; E. C. Wetmore, Sec., and Lee Burt Manager.

THE ANTRIM IRON CO.

has a furnace located at Mancelona, Mich., being near the northern end of the lower peninsula, in a fine hardwood region. The furnace was operated during the past year—1886—198 days.

No. of tons of pig iron made, 9,414.

No. of tons of pig iron made per day, $47\frac{1}{2}$.

No. of bushels of charcoal used per ton of iron made, $86\frac{1}{2}$.

Average percentage of furnace yield of the ore used, 59 1-7%.

Kind of ore used, Cleveland, Lake Superior mine, Jackson mine, Detroit mine, Winthrop and Iron Cliff Co.'s ore.

Pig iron sold at an average price of \$17.50 per ton.

E. Fitzgerald, manager.

Since writing the foregoing I have been furnished by the agent with the following which I regard as valuable:

RECORD OF THE ANTRIM IRON FURNACE.

The furnace at Mancelona has been from the time it passed under the present management, extremely successful. Its record during the past year will compare favorably with any charcoal furnace in the country.

The stack is 48 feet high, and the diameter of the bosh is 8 feet 6 inches—not by any means a large furnace. As stated below, the limestone for fluxing was from Petoskey.

The following is a statement of the working of the Antrim furnace for the year ending June 1st, 1887:

Days run.....	340
Bushels of charcoal used.....	1,312,680
Tons of ore used.....	27,064
Tons of limestone used.....	1,122
Furnace charges run.....	43,171
Blank charges run.....	585
Tons of pig iron made.....	16,152
Bushels of charcoal per ton of iron.....	81½
Pounds of limestone per ton of iron.....	156
Pounds of ore smelted per ton of iron.....	3,754
Pounds of ore smelted per bushel of coal.....	46½
Average number of gross tons of pig iron made per day.....	47½
Per cent of yield of ore.....	60
Per cent of hematite ore used.....	80
Per cent of specular ore used.....	20
Average blast pressure.....	3½ lb
Average blast temperature.....	850°
Average steam pressure.....	75 lb
Average revolutions per minute of blowing engine.....	47

The oven is on the Player plan, having 27 U pipes, each 12 feet high, furnishing 950 degrees temperature of blast. The engine used is a Weimer; 16x30 steam cylinder, and 30x48 wind cylinder.

The ore used were Lake Superior Iron Co.'s Specular, Lake Superior Old Mine Hematite, Cleveland Iron Co.'s Fine Scotch, Winthrop Hematite Co.'s Mitchell. Petoskey limestone was used, and the wood used for coaling was of excellent quality—principally maple, beech and elm.

The largest day's run by this furnace was fifty-six tons.

The furnace is advantageously situated on a small inland lake and on the line of the Grand Rapids & Indiana railroad. The ores are received direct from the mines by rail, and are dumped into the stock house from an elevated track. The freight of the ore from the mines laid down in the stock house is \$1.60 per ton. Freight to Chicago on the iron \$2.25 per ton. The wood costs from \$1.25 to \$1.35 per cord. Wages paid, \$1.25 to \$2.00 per day.

These figures and statistics were taken direct from the books of the company. Since the company took possession of the property, March 15th, 1886, the machinery has all been thoroughly overhauled, the stack relined, the oven

repaired and an additional one built. Besides all this, a 75-barrel lime kiln has been built and 33 charcoal kilns erected—making altogether 43 kilns (of 50 cords capacity) for the manufacture of coal. They have increased their stock room for ore to double its former size, relaid and repaired all tracks, trestles and tramways, built an addition to their store 28x60 feet in size, and a large and substantial barn for stabling their own horses. They are building a new brick engine and boiler room, 40x80 feet in size, and are now making preparations for the erection of a duplicate stack and a new iron elevator shaft. In fact, it is extremely difficult to say just when or where the company will leave off remodeling, rebuilding and making additions and improvements.

The indications are that the present stack will not be blown out for six or eight months to come.

The credit is due to Messrs. Fitzgerald, the agent, and to James Mackey, the founder; the latter is a practical furnaceman having acquired his knowledge by working in every department of labor connected with a furnace.

Every one familiar with furnace work knows how much of the success depends on the founder.

BANGOR FURNACE COMPANY.

The Bangor furnace is situated in the pleasant village of Bangor, in Van Buren county, in a comparatively old and settled portion of the State, still, there is yet a fair supply of hard wood timber for fuel. The ore is brought from Escanaba to St. Joseph by boat, and thence 27 miles by rail, via. the C. and West Michigan R. R., to the furnace. The originators of the enterprise deem it a mistake that the furnace was not placed on the lake, so as to save all railroad cost of the ore. The furnace has been leased to the Spring Lake Iron Company, which company will operate the furnace the coming year.

No. of days the furnace was in blast in 1886-----	305
Total number of tons of iron made-----	12,941
Furnace yield of ore, <i>i. e.</i> , No. lbs. of iron to 100 lbs. of ore-----	60%

They used a mixture, $\frac{1}{3}$ specular and $\frac{2}{3}$ hematite. Ores, L. S. mine specular and L. S. hematite, Winthrop, Chapin, Great Western ores. The charcoal cost on the average six cents per bushel. Height of furnace stack, 51 feet, use bell and hopper, diameter of bosh, $10\frac{1}{2}$ feet.

W. H. Nelson, Superintendent, Bangor, Michigan.

PINE LAKE IRON COMPANY

operates a furnace at Iron-ton, in Charlevoix county, which has been in blast

but a portion of the past year. It is now idle, and has been for two months preceding the close of the year. Total number of tons of iron made, 5,070.

R. M. Cherrie, President, Ironton, Michigan.

THE PENINSULAR IRON COMPANY

operates a furnace in Detroit. Height of stack, 42 feet; diameter of bosh, 9½ feet.

No. of days that the furnace has been in blast in 1886.....	220
No of tons of pig iron made.....	5,263
No. of bushels of charcoal used per ton of iron made.....	106
Average total in lbs. of bushels of charcoal	17
The charcoal was made of beech and maple 50%, and 50% elm, ash and oak.....	
Average yield of ore in the furnace	58.68%

Ores used were from the Milwaukee, Rolling Mill and Norrie mines, soft ores, and of hard ores from Champion, Barnum, Lake Superior and Michigamme mines.

Solon Burt, Secretary.

THE DEER LAKE IRON COMPANY'S

furnace is located about two miles northwest of Ishpeming, in the Upper Peninsula. It produced the last year 10,898½ tons of pig iron.

One remarkable work done at this furnace during the past year was re-lining the stack without extinguishing the fires, an operation that was successfully performed. The furnace was "banked up," the burden thoroughly covered, provision made for the escape of the gas, and the men entered the inside of the stack and took down the old lining and replaced it with new in as thorough a manner as could be desired.

Wm. H. Rood, President, Ishpeming, Michigan.

VULCAN FURNACE CO.

was organized in 1882. James McMillan, Prest ; Wm. C. McMillan, Sec. ; Hugh McMillan, Treas. ; Lee Burt, Manager. General business office Newbury & McMillan's building, Detroit, Mich.; manager's office at the Detroit Iron Furnace Company's Works, Detroit, Michigan, manufacturers of charcoal pig iron for car-wheel and malleable iron.

The Vulcan furnace is at Newbury, in Luce county, in the upper peninsula, and is one of the most substantial and best appointed furnaces in the State. The local superintendent is Royal A. Jenney, Newbury, Mich.

Height of furnace stack is 53 ft.

Diameter of bosh, 10', 6".

Seven tuyeres each 3" in diameter.

Diameter of top at charging line, 7', 3".

Hearth is water jacketed.

Charged with Lee Burt's patent charging apparatus.

Capacity of furnace is 50 to 55 tons of iron per day.

Average yield of ore in the furnace 58%.

Ores used comprise a suitable mixture of hard and soft ores from the Marquette range mines. The furnace went into blast Sept. 1, 1885, and will be blown out for repairs about April 1, 1887, at which time it will have made a total output during the blast of upwards of 28,000 gross tons. The delay will be as brief as possible, when the furnace will again be at work. It is confidently predicted that the furnace will outdo its former record. Product for 1886 was 16,360 gross tons of pig iron.

Table showing product of Michigan Blast Furnace for the years given:

Name of Company.	1884.	1885.	1886.
Eureka Iron and Steel Works, Wyandotte.....	6,000	10,904	11,668½
Gaylord Iron Company, Detroit.....	7,200	4,803	8,093
Detroit Iron Furnace Company, Detroit.....	6,205	13,619½	6,741
Union Iron Company, Detroit.....	8,000	3,303	6,000
Peninsular Iron Company, Detroit.....	7,200	7,439	5,263
Bangor Furnace Company, Bangor.....		6,891½	12,941
Elk Rapids Iron Company, Elk Rapids.....		16,077½	17,434½
Spring Lake Iron Company, Fruitport.....		17,217	17,768
Jackson Iron Company, Fayette.....		8,456	10,581
Vulcan Iron Company, Newberry.....		11,426	17,360
Deer Lake Iron Company, Ishpeming.....		9,245½	10,898½
Iron Cliff Company, Negaunee.....		15,718	11,079
Antrim Iron Company, Mancelona.....			9,414
Pine Lake Iron Company, Ironton.....			5,070
Mortel Furnace Company.....			7,666
Total.....		125,190	148,952

COAL.

COAL MINES.

There is nothing new to record in the coal mining business in this State. It is an industry that in Michigan is never likely to be of much magnitude. Nowhere has the coal seam been found to be thick enough to make it easily mined, and frequently, when it does exist in quantity that it would do to mine, the overlying rock is too soft and friable to form a roof. Although the only deposits that have been worked to any profit have been found in Jackson and Shiawassee counties, still, coal exists to some extent in many of the counties of the Lower Peninsula. I have seen very fine quality of coal dug in the southwest part of the State, in Cass, Berrien and Van Buren counties. But so far as I know, it does not exist in those localities in any appreciable quantity.

Coal has been mined in a small way, and is yet, at Williamston, and at Grand Ledge, and the coal at the former place is of a superior quality for Michigan coal, but I am informed that the deposit is wanting in a roof, and besides that the seam is thin.

No matter if the coal is ever so desirable, if the overlying rock cannot be made to support the burden, the coal cannot be mined, and this is the trouble with much of the Michigan coal. It won't pay to strip it; it is too deep down for that, and it cannot be roomed out, as the rock and dirt would come. This seems to be the trouble with the coal deposits in Saginaw Valley. There is no overlying deposit of rock of sufficient strength to support the dirt as the coal is removed. The vicinity of the city of Jackson has ever been, and still continues to be, the best coal mining section in the State. Second to this is Corunna.

The Corunna coal is harder than that at Jackson. It requires to be blasted, while at Jackson no powder is used. In addition to the cost of powder, the Corunna company pay seven cents more per ton for mining than they pay at Jackson. At Jackson the cost per ton for mining is 30 cents; at Corunna it is 37 cents. The companies in both places make the entries and turn the rooms. The miners break the coal, load it and tram it to the shaft.

There has been more profit in the business in the past year than there was in 1885. Those engaged in mining state that they can sell all they can get out now. Mr. Kincaid, the agent at Corunna, says he wants men, the trouble he has mainly is to get good miners and to keep them. The men cannot make good wages until they get used to working here, and learn to exercise skill in placing their blasts so that they shall be effective. At first men are almost certain to make a failure and they get discouraged and quit. The experienced miners, it is claimed, make good wages. The Corunna company is working 75 men now. The mine is looking well and is in good shape. The vein is 2 to 4 ft. thick, averaging about 3 ft. They are mining about 1,500 tons a month. Could sell three times the amount if they could get it out. The safety of the work is illustrated by the fact that only two serious casualties have occurred in ten (10) years; one man was killed and another had a leg broken. The fatal accident was due to blasting.

At Jackson the largest producers of coal are R. W. Emerson Co., the JACKSON Coal Company. Their old mines, however, are exhausted and they are now exploring with the drill for more coal.

Besides the Jackson Coal Co. the only other producers are the STAR Coal Co. and the STANDARD. These are both new companies and are operating shafts that were opened in 1885.

The old mines, Woodville, Slope, Porter, Eureka, etc., are worked out and abandoned and really at the present writing, February, 1887, there are but the two shafts in operation, the Star and the Standard.

The Star company's mine is looking first-rate. The shaft is 50 ft. deep, but the coal lies much deeper in places, owing to the surface rise of the ground. The coal is 2' 9", 3' 7", 4' thick with a good roof. The company claims to be doing well financially just now, working 65 men, and pays out \$1,700 per month for wages. The mine is not very largely opened just yet. The company holds the lease of the mining right to 460 acres in one body. The lease is for 30 years at 15c. per ton royalty. The company sells 15 tons per day to the State Prison, and it is the work of only two teams to haul it from the shaft.

It is reported that an effort is to be made to mine coal extensively at FLUSHING. Some mining has been done here for many years but the coal seam has a poor roof, as one of the important drawbacks, and only a small quantity has ever been obtained in any year.

The following table shows the product of the Michigan coal mines for the years indicated :

[illegible]

SALT.

SALT.

It is well known that Michigan leads every other State and Territory in the Union in the production of salt. It is an industry that has grown up very rapidly in this State and has become of immense proportions. Formerly the production was confined to the Saginaw valley, but now there are wells affording equally rich brine on the shores of Lake Michigan. In all there were pumped in this State, during 1886, 297 wells, which range in depth from 750 feet to 2,000. The average depth is about 1,000 feet.

The following is from the report of the State Salt Inspector, Geo. W. Hill, and covers the whole subject of the salt production in this State for the year 1886. It shows an actual production of over 4,000,000 barrels of salt in the past year, which sold at an average net price of 65 cents per barrel of 280 pounds. It is expected that prices will rule lower in 1887.

There is a Michigan State Salt Association with general office at East Saginaw. W. R. Burt, President.

The law requires that the report shall contain :

1. The number of districts into which the salt-producing territory of the State may then be divided, with the name and locality of each, and the number and capacity of the works of each district.
2. The quantity and quality of salt inspected in each district during the preceding year.
3. The amount of money received and expenses incurred under this act.

THE SALT DISTRICTS.

The salt-producing territory of the State is divided into nine districts, having a manufacturing capacity as follows :

District No. 1, Saginaw County—

Has 52 salt companies, with 45 steam, 12 pan blocks, and 4,000 solar salt covers, having a manufacturing capacity of 1,400,000 barrels of salt.

One steam and one pan block belonging to T. Jerome & Co., of the above, destroyed by fire this season.

District No. 2, Bay County—

Has 31 salt companies, with 34 steam blocks and 500 solar salt covers, with a manufacturing capacity of 1,300,000 barrels of salt.

District No. 3, Huron County—

Has 16 salt companies, with four steam, eight pan blocks, and with a manufacturing capacity of 350,000 barrels.

District No. 4, St. Clair County—

Has 12 salt companies, with 10 steam and two pan blocks, with a manufacturing capacity of 600,000 barrels.

District No. 5, Iosco County—

Has eight salt companies, with eight steam blocks, having a manufacturing capacity of 300,000 barrels of salt.

District No. 6, Midland County—

Has four salt companies, with three steam and one pan block, having a manufacturing capacity of 100,000 barrels of salt.

District No. 7, Manistee County—

Has 10 salt companies, with nine steam and one pan block, having a manufacturing capacity of 900,000 barrels of salt.

District No. 8, Mason County—

Has two salt companies, with two steam blocks, having a manufacturing capacity of 200,000 barrels of salt.

District No. 9, Gratiot County—

Has one salt company, with one steam block, having a manufacturing capacity of 15,000 barrels of salt.

RECAPITULATION.

From the above we find there are 136 firms engaged in the manufacture of salt, during the year 1886, operating 116 steam and 24 pan blocks. Total number of blocks 140, and 4,500 salt covers, with an estimated manufacturing capacity of 5,165,000 barrels of salt :

DISTRICT NO. 1—SAGINAW COUNTY.

For whom Inspected.	Barrels.
Nason, Allan & Co.....	19,120
Green, Ring & Co.....	56,062
Cameron & Merrill.....	39,313
Saginaw Manufacturing Co.....	13,974
N. & A. Barnard.....	45,686
D. Hardin.....	12,211
D. Hardin & Co.....	7,400
Williams Bros.....	24,634
Brand & Hardin.....	12,536
Wright Lumber Co.....	47,878
Wylie Bros.....	20,621
J. H. Pearson & Son.....	17,238
C. K. Eddy & Son.....	34,372
Redmond & Nolan.....	3,351
J. H. Freeney.....	9,393
E. R. Phinney.....	7,968
W. A. O'Donnell.....	12,245
Frank Bischkee.....	1,924
Wiggins, Cooper & Co.....	30,359
Eaton, Potter & Co.....	11,334
Rust Brothers & Co.....	25,738
Gebhardt & Estabrook.....	18,727
Burnham & Still.....	1,902

For whom Inspected.	Barrels.
D. S. Chapin.....	2,899
W. B. Stillman & Co.....	4,976
Sample & Camp.....	18,261
Nelson Holland.....	33,077
Warner & Eastman.....	21,536
C. & E. TenEyck.....	15,224
J. G. Owen.....	27,094
J. J. Winsor.....	8,650
W. L. Webber (trustee).....	34,731
Tyler & Son.....	20,046
Saginaw Lumber & Salt Co.....	38,684
C. Merrill & Co.....	44,149
G. E. Anthony.....	15,897
Whittier & Co.....	11,097
Backus & Binder.....	5,070
W. B. Mershon.....	20,057
E. F. Gould.....	23,487
T. Jerome & Co.....	24,821
A. T. Bliss (upper mill).....	47,132
Stevens & La Due.....	38,226
Sanborn & Hill.....	29,958
C. L. Grant & Co.....	12,120
A. T. Bliss & Bro (lower mill).....	43,175
E. C. Chapman.....	13,693
Rust, Eaton & Co.....	29,948
Hamilton, McClure & Co.....	60,947
Whitney & Batchelor.....	71,831
Melchers & Nerreter.....	10,282
LaDue, Stevens & Co.....	11,971

TOTALS.

Fine, bulk.....	262,444
Fine, bbls.....	910,263
Coarse.....	49
Packers'.....	2,361
Solar.....	27,677
Second quality.....	10,970
Total bbls.....	1,213,811

DISTRICT NO. 2—BAY COUNTY.

Dolsen, Chapin & Co.....	35,722
Pitts & Cranage.....	53,511
Birdsall & Barker.....	12,068
N. B. Bradley & Sons.....	43,812
McLean, Son & Co.....	43,820
Wm. Peter.....	29,549
Eddy, Avery & Eddy.....	33,952
F. E. Bradley & Co.....	34,392
L. L. Hotchkiss & Co.....	57,860
Laderach Bros.....	15,749
Malone & Co.....	42,654
H. W. Sage & Co.....	73,160
Keystone S. & L. Co.....	461
. B. Curtis (agent).....	34,357
C. E. Lewis.....	9,251
mith Bros & Co.....	23,012

For whom Inspected.	Barrels.
J. R. Hall.....	47,258
E. Hall.....	27,208
Butman & Rust.....	20,489
McEwan Bros & Co.....	37,761
Miller & Lewis.....	32,998
Rust Bros & Co.....	36,870
G. C. Meyers.....	10,197
W. B. Rouse.....	22,900
Michigan Pipe Co.....	14,102
E. Y. Williams & Co.....	25,327
Eddy Bros & Co.....	27,772
Murphy & Dorr.....	10,125
Folsom & Arnold.....	24,608
T. H. McGraw.....	22,939
Atlantic Salt Co.....	3,500

TOTALS.

Fine bulk.....	186,431
Fine.....	709,077
Coarse.....	568
Packers'.....	1,815
Solar.....	3,500
Second quality.....	5,993
Total bbls.....	907,384

DISTRICT NO. 3—HURON COUNTY.

Huron Dairy Salt Co.....	22,856
Port Hope Salt Co.....	50,022
R. C. Ogilve.....	17,333
New River Salt Co.....	.....
Caseville Salt Co.....	11,072
C. F. Soule.....	2,665
Port Crescent Salt Co.....	8,395
T. Winsor & Co.....	1,278
Port Austin Manufacturing Co.....	11,990
Ayres & Co.....	29,914
Frank Crawford.....	693
Bennett Haskell.....	2,023
Cleveland Stone Co.....	4,268
D. L. Davis.....	24,773
Worthington & Sons.....	18,481
R. Winsor & Sons.....	33,906

TOTALS.

Fine bulk.....	25,171
Fine.....	212,084
Packers'.....	1,770
Second quality.....	2,644
Total bbls.....	240,569

DISTRICT NO. 4—ST. CLAIR COUNTY.

R. B. Baird.....	19,676
Thompson Bros.....	71,500
Marine City Stave Co.....	100,363
J. A. Wanzey & Sons.....	8,873
Lester & Roberts.....	2,812

For whom Inspected.	Barrels.
Germania Salt Co.....	6,226
Johnson & Henry.....	50
Excelsior Salt Works.....	2,007
Marine City Salt Works.....	15,526
Marine City Salt and Brick Works.....	6,525
Algonac Salt Co.....	8,113
Toledo Salt Co.....	9,431

TOTALS.

Fine bulk.....	3,450
Fine.....	229,079
Coarse.....	816
Packers'.....	3,228
Second quality.....	13,929
Total bbls.....	250,602

DISTRICT NO. 5—IOSCO COUNTY.

East Tawas Lumber & Salt Co.....	29,333
Pack, Woods & Co.....	52,673
Gratwick, Smith & Fryer.....	46,584
J. E. Potts & Co.....	23,004
Oscoda Salt & Lumber Co.....	12,229
Emery Bros.....	28,984
Iosco B. S. Co.....	19,096
Winona Salt & Lumber Co.....	23,240

TOTALS.

Fine.....	234,367
Coarse.....	30
Packers'.....	525
Second quality.....	221
Total bbls.....	235,143

DISTRICT NO. 6—MIDLAND COUNTY.

Wm. Patrick.....	19,361
Chas. Brown.....	7,313
Larkin & Patrick.....	21,960
Sam. Foster.....	18,487

TOTALS.

Fine.....	61,226
Second quality.....	5,895
Total bbls.....	67,121

DISTRICT NO. 7—MANISTEE COUNTY.

Davis, Blacker & Co.....	37,401
Louis Sands.....	34,460
Manistee Salt and Lumber Company.....	96,464
R. G. Peters.....	197,481
Wheeler, Magill & Co.....	54,926
Engelman & Kitzinger.....	34,305
Reitz Brothers.....	63,013
Stronach Lumber Company.....	53,480
Canfield & Wheeler.....	69,672
John Canfield.....	61,871

TOTALS.	
Fine bulk.....	19,727
Fine	620,744
Coarse.....	2,154
Packers'.....	12,422
Second quality.....	2,856
Total bbls.....	683,103

DISTRICT NO. 8—MASON COUNTY.

For whom Inspected,†	Barrels.
Pere Marquette Lumber Company.....	70,309
Thos. R. Lyon (agent).....	8,912

TOTALS.

Fine.....	75,318
Coarse.....	276
Second quality	3,627
Total bbls.....	79,221

DISTRICT NO. 9—GRATIOT COUNTY.

St. Louis Salt Company.....	350
-----------------------------	-----

TOTALS.

Fine.....	350
Total bbls.	350

RECAPITULATION.

District No. 1—Saginaw County.....	1,213,764
District No. 2—Bay County.....	907,384
District No. 3—Huron County.....	240,569
District No. 4—St. Clair County.....	250,602
District No. 5—Iosco County.....	235,143
District No. 6—Midland County.....	67,121
District No. 7—Manistee County.....	683,103
District No. 8—Mason County.....	79,221
District No. 9—Gratiot County.....	350

TOTALS.

Fine bulk	497,223
Fine	3,051,508
Coarse.....	38,932
Packers'.....	2,221
Solar	31,177
Second quality.....	71,235
Total	3,677,257

The above table shows an increased inspection over 1885 of 379,854 barrels of salt, but does not show the amount actually manufactured during the fiscal year of 1886:

Add to the amount inspected.....	3,677,257
Salt now in bins.....	933,970
Total.....	4,611,227
Deduct salt inspected in December, January and February, 1886.....	513,284
Amount actually manufactured fiscal year 1886.....	4,097,943

Showing an actual production over any preceding year of 798,169 barrels.

Table showing increased and decreased inspection per district:

County.	1885. Barrels.	1886. Barrels.	Increase.	Decrease.
Saginaw	1,178,910	1,213,764	34,854	-----
Bay	951,810	907,384	-----	44,426
Huron	306,664	240,569	-----	66,095
St. Clair	125,014	250,502	125,588	-----
Iosco	236,543	235,143	-----	1,400
Midland	62,710	67,121	4,411	-----
Manistee	432,637	683,103	246,466	-----
Mason	-----	79,221	79,221	-----
Gratiot	3,115	350	-----	2,765
Total income	3,297,403	3,677,257	512,540	114,686

COMPARATIVE TABLE.

The following table shows the amounts of the various grades of salt inspected in Michigan since 1869, the first year of the establishment of the State inspection law:

Year.	Fine.	Packers.	Solar.	Second quality.	C. coarse.	Total.
1869	513,908	123,908	15,264	19,177	-----	561,288
1870	568,326	17,869	15,507	19,650	-----	621,352
1871	655,923	14,677	37,645	19,930	-----	728,175
1872	672,034	11,110	31,461	19,876	-----	724,481
1873	746,702	23,671	32,267	20,706	-----	823,346
1874	960,757	20,090	29,391	16,741	-----	1,026,976
1875	1,027,866	10,233	24,336	19,410	-----	1,081,856
1876	1,402,410	14,233	24,233	21,668	-----	1,462,729
1877	1,590,841	20,839	22,818	26,818	-----	1,660,997
1878	1,770,361	19,267	33,544	32,615	-----	1,855,884
1879	1,997,350	15,641	18,020	29,027	-----	2,058,040
1880	2,559,037	16,691	22,237	48,623	-----	2,676,588
1881	2,673,910	13,885	9,683	52,821	-----	2,750,299
1882	2,923,542	17,208	31,335	60,222	-----	3,037,317
1883	2,828,987	15,424	16,735	33,526	-----	2,894,672
1884	3,087,034	19,308	16,957	38,508	-----	3,161,806
1885	3,230,626	15,480	19,840	31,428	-----	3,297,403
1886	3,548,731	22,221	31,177	71,235	3,898	3,677,257
Total	-----	-----	-----	-----	-----	34,100,469
Salt manufactured prior to 1869	-----	-----	-----	-----	-----	3,282,117
Total amount of salt produced in Michigan to date, barrels	-----	-----	-----	-----	-----	37,382,586

GYPSUM.

GYPSUM.

The gypsum deposits, quarries and mills, etc., in this State have been fully described in previous reports—particularly in the report of 1878, and in that of 1881, and I do not deem it necessary to go into any further details of the subject at the present time beyond giving the tables showing annual production.

TABLE Showing the Amount of Land and of Calcined Plaster produced in Michigan, for each year since 1866, and for previous years.

Years.	Land Plaster, Tons.	Stucco—Barrels, 300 lbs. each
For years previous to 1866.....	*100,000	80,000
1866.....	14,604	-----
1867.....	17,439	-----
1868.....	28,887	34,996
1869.....	29,996	41,187
1870.....	31,437	46,179
1871.....	41,126	48,685
1872.....	43,536	59,767
1873.....	44,972	82,457
1874.....	39,126	82,449
1875.....	27,019	61,120
1876.....	39,131	64,386
1877.....	40,000	55,000
1878.....	40,000	48,346
1879.....	43,658	50,800
1880.....	49,570	106,004
1881.....	33,178	112,813
1882.....	37,821	135,655
1883.....	33,225	201,133
1884.....	27,888	156,677
1885.....	28,181	141,575
1886.....	29,398	153,274
Total product.....	820,142	1,686,469

* Partly estimated.

TABLE Showing the product of Land Plaster and Stucco produced by the different Companies in Michigan, in the Years indicated.

Name of Company.	Number of Tons of Land Plaster produced by Michigan Companies.								Number Barrels of Stucco produced by Michigan Companies.							
	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.
Godfrey & Bro.....	9,117	9,000	6,422	6,080	5,682	4,593	4,467	4,560	-----	23,000	27,500	30,274	37,000	30,453	30,942	28,273
Grand Rapids Plaster Co.	8,970	12,000	6,375	7,512	5,013	3,044	4,143	3,832	-----	23,500	20,400	32,854	40,000	24,390	26,498	28,627
Wyoming Mills.....	7,000	10,000	6,093	6,801	4,400	3,082	4,059	3,714	-----	-----	-----	-----	12,000	13,108	11,193	11,327
Union Mills.....	4,500	7,500	6,716	8,298	5,500	3,185	3,663	3,687	-----	35,000	34,913	23,074	30,000	23,176	15,654	18,027
D. Noble & Co.....	10,585	9,570	6,572	6,037	4,000	3,202	3,900	1,947	-----	24,504	30,000	27,893	38,000	30,288	26,344	28,760
Smith, Bullard & Co.....	1,586	1,500	1,000	2,993	4,600	4,122	4,346	6,030	-----	-----	-----	11,817	30,961	23,961	20,797	27,113
Alabastine Co.....	-----	-----	-----	-----	4,082	6,680	3,606	5,608	-----	-----	-----	-----	13,172	11,321	10,147	11,147
Geo. H. White & Co.....	1,900	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Totals	43,658	49,570	33,178	37,821	33,225	27,888	28,181	29,398	-----	106,104	112,813	135,655	201,133	156,677	141,575	153,274

COPPER MINES.

THE COPPER MINES.

About the close of the year 1886 the copper mining business had a favorable outlook. The price of Lake copper had advanced to 11 or 12c. per lb. and it seemed likely that those figures would be maintained; thus a reasonably prosperous year was anticipated. But, unfortunately for the mining companies, as the season advanced the price of copper again dropped to 10c., and has not advanced above it thus far during the fourth part of the year 1887.

The action of the Calumet and Hecla company in selling a large amount of copper recently for 10c. per lb. is, generally, severely condemned by other Lake Superior companies.

It is claimed that the price is thus unnecessarily depressed and brought below the point at which many of the other Lake Superior companies can afford to produce it.

On the other hand, in justification of the action taken by the Calumet & Hecla, it is stated that such large sales at low price drive out competition, by forcing the closing up of many mines in other copper mining regions, thus lessening the aggregate production and bringing it more nearly to an equality with the demand.

The production of copper has increased more rapidly, of late, than the consumption, so that the price has steadily decreased until it has reached so low a figure that it would seem to be impossible, judging from our past experience of the cost of production, that it can be mined and sold without loss, at the prices which now prevail.

Our Lake Superior copper companies, however, have fully appreciated the signs of the times and have constantly sought to reduce the mining and manipulating cost of the metal to such a degree as should enable them successfully to meet the exigences of the case, that is to make the cost so low, that there should still be a profit to them in the business.

I have endeavored to go over this ground so fully in previous reports and to explain the methods by which this reduction of cost has been effected and to show how skillfully and economically all the work in our copper mines is per-

formed, that I deem it unnecessary to dwell upon the subject further at this time. One thing is apparent: the days of operating small copper mines have passed. It is only by the vast increase in the magnitude of the work that the relative cost has been so greatly cheapened. Energy, economy, the greatest mining skill, the use of every mechanical appliance, all have their place, all are brought into requisition, and the result is the marvellous success attained at the Franklin, Atlantic, Osceola, Quincy and other of our great copper mines.

In writing of the copper mines I shall be as brief as possible. I have described them so fully heretofore that in going through the mines again the past winter I find very little to state that I have not previously written, except, of course, the statistics for the year.

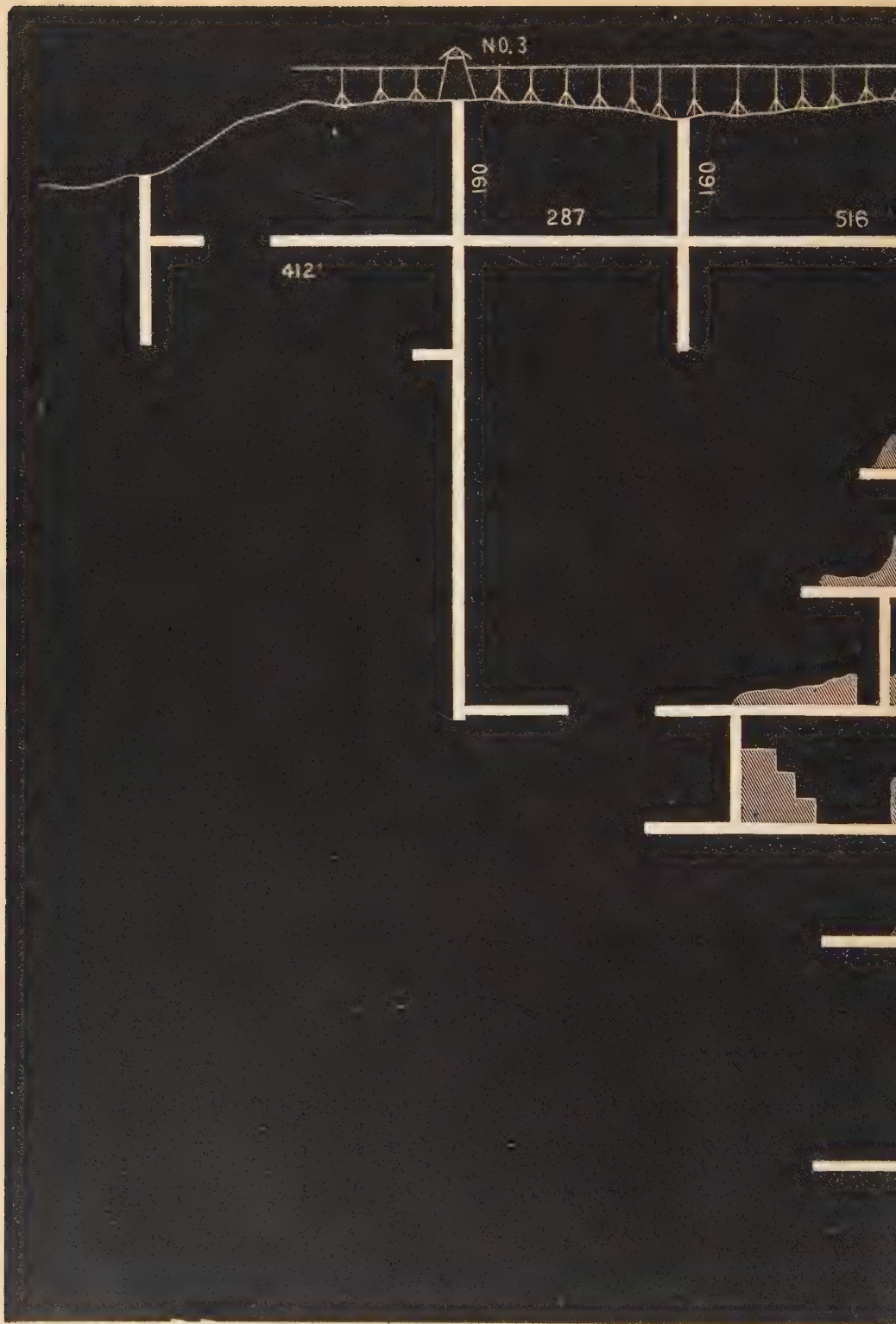
The mines at the extremes of the range are those which are the most depressed. In both Keweenaw and in Ontonagon counties the mines are nearly all idle or working in a small way on tribute. Commencing with

THE CONGLOMERATE,

is the most northerly of the mines that have produced any copper in the past year. I find little to add to what was given in my previous report. A few tributers extracted 22 tons and 505 lbs. of refined copper, all barrel work and small masses obtained in the old Northwest vein and in the upper levels of the Conglomerate.

Those who are acquainted with the history of our copper mines will remember that this mine, under the various names which it has had in the past, is one of the oldest locations in the Peninsula. Formerly they worked here only in fissure veins; in veins holding chiefly mass copper, which cross the range at practically right angles to the trend of the formation and which dip vertically, or nearly so. Several of these veins have been opened and worked on this property and all the money derived from the sales of the copper obtained, together with that advanced by the stockholders, to the amount of the capital stock, of the several organizations, has been expended on the location. Not a penny of profit has passed into the pockets of the unfortunate shareholders.

These companies were known as the Northwest Copper Mining Association, which was formed in 1847, and owning 4,320 acres of land in T. 58 N., R. 30 W.—the mine which had been prospected. In 1849 the capital stock was increased and the company re-organized under the title of The Northwest Mining Co. In the succeeding ten years the company expended \$939,000 and thus exhausted its capital stock. In 1861 a re-organization was effected, taking the name of the Pennsylvania Mining Company. The estate comprised 2,880 acres of land, to which were soon added by purchase 6,000 acres of timbered land.



CONGLOMERATE MINE, 1887.
one inch.



In 1863 the estate was divided and another company organized called the Delaware Mining Company, to which was set off 720 acres of land on the range south of the old mine.

Both these companies worked extensively and expended together, in mining and surface improvements, the aggregate sum of \$2,000,000. It seems incredible at this time that so much money should have been paid out with so inadequate a result.

But we must bear in mind that it was during the time of the war and just after it, when prices for all commodities and for labor were higher than they have ever been at any other time in this country. They erected at the Pennsylvania the largest stamp mill that, up to the time, had ever been seen on the lake, and at that period such machinery was enormously costly. Of course the value of copper was at least three times its present cost. •

In 1866 the companies having failed to meet their pecuniary obligations, the property came into the possession of the bondholders who operated the mines for two years, when the bonds were purchased by Mr. E. M. Davis, of Philadelphia, who assumed charge of the affairs and in 1876 perfected the fourth organization—The Delaware Copper Mining Company. Work was prosecuted by this company until January 1, 1881, when the estate passed to the ownership of the present company. The Conglomerate Company operated extensively for three years—in opening a mine in what is known as the Allouez Conglomerate—a copper bearing belt that underlies the greenstone, and in making extensive surface improvements. In this way it has expended \$1,300,000. Everything is substantial, the houses are well built, are numerous and commodious. The machinery is new, powerful and of approved pattern. At Lac La Belle the company completed one of the best stamp mills in the State and built and equipped a railroad to connect it with the mine. There is everything complete and in order for operating a large mine, but all is practically idle, though well cared for by the agent, Mr. Chas. H. Palmer, who resides on the premises.

The extent of the mine openings in the Conglomerate belt and in the old Northwest vein, are shown in the accompanying maps. The Conglomerate has a width of 25 feet, which Mr. Palmer, in 1884, found to yield 9 43-100 lbs. of copper to the ton of rock, treated in the mill.

And it was also found to cost \$1.58 per ton to mine and treat the rock. At present price of copper it is not possible to operate the mine, except at great loss.

I did not learn that the company has any mature plans for the future.

General office of company 308 Walnut street, Philadelphia.

Geo. H. Lewars, Secretary; Chas. H. Palmer, Agt., Delaware, Mich.

The following table shows the copper production at this mine:

Years.	Tons.	Pounds.	Years.	Tons.	Pounds.
Years previous and 1855.....	654	80	1874.....	40	1,271
1856.....	1	1,348	1875.....	12	1,260
1857.....	29	543	1876.....	88	1,701
1858.....	83	100	1877.....	16	1,417
1859.....	74	144	1878.....	140	345
1860.....	121	97	1879.....	70	12
1861.....	54	1,920	1880.....	116	1,814
.....			1881.....	193	91
1864.....	111	660	1882.....	335	1,681
1865.....	241	861	1883.....	111	117
1866.....	64	90	1884.....	599	691
1867.....	163	660	1885.....	20	1,155
1872.....	81	1,161	1886.....	22	505
1873.....	170	743			
Total.....				3,618	467

THE CENTRAL MINING COMPANY

has the honor of being the only company in Keweenaw county that is fully operating. The others are either all idle or are only working partly, but the Central pursues the even tenor of its way, keeps up its usual annual product, and declares regularly its accustomed dividend.

It is a very interesting mine, and the affairs of the company are exceedingly well managed.

The mine is in a fissure vein, which dips vertically, and crosses the formation. The copper is nearly all found in the vein. The amygdaloid belts cut by the vein never did produce much copper, and the conglomerate, which yielded considerable copper a few years ago, has ceased to be of value, and is now no longer worked in.

The mine is found to be rich or poor at times as the case may be. At the time of my visit the mine was looking well. There was a world of fine masses of copper in the bottom, and at the rock house, also, at Eagle Harbor, ready for shipment in the spring. In the rock house were 10 masses, each weighing four tons and upwards. Subsequently—two months afterwards—I was told by Capt. Dunstan, that the mine was looking poor. And so it varies. I have been down in the mine when there was a world of copper in sight, and again, the next time I visited it, it would be almost barren.

The mine has become so deep that more powerful hoisting machinery is required, and, acting on this necessity, the company has just completed the erection of a new plant that will probably prove adequate to the work. The drum is 21 feet diameter at large end, and 14 feet at small end, and 12 feet face.

The conical drum for the counter weight is 6 feet and $13\frac{1}{2}$ feet diameter, respectively, at the ends, and 14 feet long. The two engines to operate them are each 30"x60", built by Frazier & Chalmers, Chicago.

The steam raises the brake, so that if the steam is shut off the drum stops. The new stone building for the machinery is 60 feet by 60 feet by 18 feet in height. The counter balance runs on the incline, running down as the skip comes up. It is provided with automatic brake on the counter weight car, so that in case of breakage of the skip rope, or other equivalent contingency, the car will stop instantly. There is also on the skip machinery an automatic cut-off, to prevent hoisting too far. The skip comes to the top when, automatically, the cut-off acts to reverse the engine. The matter of this machinery has been in contemplation for several years, and it has been the endeavor to incorporate every device that should render the work effective and safe. It is all plain and substantial, as with everything else at the Central; there is nothing for show. The advantage of this new machinery will be great. It takes, with the old machinery, seven minutes to hoist the skip, holding but one-half ton of rock. With the new the estimated time is but one and one-half minutes, and the skip carrying one and one-half tons.

The copper ground is now all south of No. 2 shaft, as may be seen by consulting the accompanying map. The depth of No. 2 is, vertically, 2,220 feet. The company works about 100 men.

I notice a considerable improvement in the appearance of the location: all the houses have been painted and rendered more neat and comfortable in appearance. The workmen at the Central are all old employees; that is they are nearly all men with families and have, many of them, lived on the location for years. The company provides them with good houses, they earn satisfactory wages and there is never any discontent.

The statistics of the year's work are shown in the following statement by officers of the company:

The directors present the following statement of the operations during the year 1886:

The production of mineral was 1,600 755-2000 tons, and the quantity smelted was 1,590 815-2000 tons, which yielded about 79 per cent., or 2,512,886 pounds of refined copper.

The following is a summary of the year's business:

PRODUCTION.

Copper sold.....	2,033,922 lb, av. 10 67-100c.	\$217,047 79
Copper on hand.....	478,964 lb, at 10½c.	50,291 22
	2,512,886	\$267,339 01
Silver.....		432 70
		\$267,771 71
Mineral at mine December 31st, 1885, 161 1925-2000 tons, at \$145 per ton.....	\$23,919 56	
Mineral at mine December 31st, 1886, 174 1885-2000 tons, at \$125 per ton.....	21,866 56	
		2,053 00
Net value of product of 1886.....		\$265,718 71
Add interest received.....		3,907 34
		\$269,626 05

COSTS.

Working expenses at mine.....	\$153,471 76	
Construction account at mine.....	21,540 05	
Smelting, freight, and all other expenses.....	42,774 90	
		217,786 71
And showing a net gain in 1886 of.....		\$51,839 34
There has also been paid for lands purchased.....		24,017 01
Making the net increase in assets.....		\$27,822 33
The surplus from 1885, after payment of dividend, was.....		228,281 98
Making the net surplus, December 31st, 1886.....		\$256,104 31
as shown in detail in the annexed statement of assets and liabilities, and out of which a dividend of two dollars per share (\$40,000) was paid February 1st, 1887.		

The item, construction, embraces the payments made in constructing and erecting the new hoisting plant named in last year's report, with the necessary connections, and alterations in roadways and shafts. The new machinery will shortly be in operation, and its completion will require a further expenditure of about \$15,000 during the current year.

The lands purchased comprise two tracts, one of 1,600 acres adjoining our mine and known as the "Northwestern mine;" the other of 1,920 acres, about a mile distant, and known as the "Madison mine." These lands are worth to us fully the sum paid for them, for their timber value alone, aside from any "mineral value" they may possess. The winding up of the companies owning these lands gave us a chance to purchase them at a reasonable price, and it would have been unwise to have neglected the opportunity and allowed the lands to pass into other hands. As we have occasion to use the timber a fair allowance for "stumpage" will be credited to the proper account, so that eventually the entire cost of the lands will be reimbursed by the timber.

The report of our agent at the mine shows the present prospects of the underground workings, and to this we refer for information regarding the mine. The usual financial statement showing assets and liabilities December 31st, 1886, is also appended.

GEORGE A. HOYT,
ROBERT PORTERFIELD,
JOHN J. CRANE,
ALBERT J. HATCH,
WM. C. STURGES,
JOHN STANTON.

Directors.

ASSETS AND LIABILITIES, CENTRAL MINING COMPANY, DECEMBER 31ST, 1886. EXCLUSIVE OF REAL ESTATE AND MINE PLANT.

<i>Assets.</i>		
Cash.....		\$22,663 37
Loans.....		92,040 00
Silver on hand.....		432 70
Copper on hand, sold.....		39,308 62
Copper on hand, unsold, 478,964 pounds.....		50,291 22
Accounts receivable.....		6,032 40
		<u>\$210,768 31</u>
<i>At Mine.</i>		
174 1865-2000 tons mineral, at \$125.....	\$21,866 56	
Cash.....	3,115 97	
Merchandise in store.....	23,360 00	
Supplies.....	32,970 24	
		<u>81,312 77</u>
		<u>\$292,081 08</u>
<i>Liabilities.</i>		
Agent's drafts.....	\$9,739 07	
Indebtedness at mine.....	18,005 30	
Accounts payable.....	8,232 40	
		<u>35,976 77</u>
Balance of assets.....		<u>\$256,104 31</u>
(Less dividend, February 1st, 1887, of \$40,000.)		

SUMMARY OF RECEIPTS AND EXPENDITURES OF CENTRAL MINING COMPANY FROM ITS ORGANIZATION TO DECEMBER 31, 1886.

<i>Receipts.</i>		
Capital stock paid in.....		\$100,000 00
Copper sold (including silver).....	\$8,114,780 19	
Copper on hand.....	50,291 22	
		<u>8,165,071 41</u>
Profit on timber sold.....		70,011 75
Total receipts.....		<u>\$8,344,083 16</u>
<i>Expenditures.</i>		
Net expenditure for mining operations, buildings and machinery, smelting and marketing copper, and incidental expenses.....	\$6,283,961 84	
Net cost of "Madison" and "Northwestern" lands.....	24,017 01	
Total expenditures.....		<u>6,307,978 75</u>
Balance of receipts.....		<u>\$2,036,104 31</u>
Deduct dividends paid.....		1,780,000 00
Net surplus, December 31st, 1886.....		<u>\$256,104 31</u>
as shown in statement of assets and liabilities.		

AGENT'S REPORT.

CENTRAL MINE, KEWEENAW CO., MICH., }
January 1st, 1887. }

John Stanton, Esq., Secretary and Treasurer, New York.

DEAR SIR:—The following report of operations at our mine during the year 1886 is respectfully submitted:

GROUND BROKEN.

Sinking in shafts and winzes 188 feet, average cost.....	\$20 26
Drifting on vein, 979 2-12 feet, average cost.....	9 02
Stoping on vein, 1,781 3-36 superficial fathom, cost.....	13 74
Stoping on vein, 22 cubic fathom, cost.....	18 00
The total amount of ground broken in openings and stopes is 3,000 cubic fathoms.	

PRODUCTION.

1,172 bbls. stamp copper, weighing.....	1,679,135 lbs.
214 hhds barrel copper, weighing.....	689,125 "
324 masses copper, weighing.....	832,495 "
Total.....	3,200,755 "
Or 1,600 755-2000 tons.	
Average yield of mineral per fathom of ground broken.....	1,066 lbs.
Average yield of ingot per fathom of ground broken.....	842 "

EXPENDITURE AT MINE.

The total expenditure for the year is as follows :

Mining and surface expenses.....	\$140,448 07
Stamp mill expenses.....	14,032 06
Taxes.....	3,658 70
Construction account.....	21,540 05
	\$178,678 88
Less rents received.....	4,667 07
Total expenses.....	\$175,011 81

SINKING.

No. 2 shaft has been sunk 80 feet to the 27th level. A winze has been sunk just opposite the shaft, from the 26th to the 27th level. We cannot determine the richness of the vein in this winze, as we only broke into it in one or two places while sinking, but where it was broken it showed good copper rock.

DRIFTING.

The 23d level south has been driven 22 feet.

The 24th level south has been driven 28 feet, and opened up some good ground. At present it is poor.

The 25th level has been extended south of No. 2 shaft 162 2-12 feet. The vein has been very changeable, but has opened up some good stoping ground.

The 26th level has been extended 318 2-12 feet south, and 140 9-12 feet north of No. 2 shaft, and has opened up considerable good copper ground. In the north drift the vein has proved much better than we expected, the copper chute being about 150 feet in length.

At the 27th level we have drifted 70 feet north and 31 feet south of No 2 shaft. The north drift has exposed a good vein about 2½ feet in thickness, but the south drift is poor.

STOPING.

Most of the stopes throughout the mine have yielded well the past year. We have considerable ground opened that shows copper, but not deemed rich enough to pay to work at the present low price of copper. The stopes back of the 24th level south have yielded some large and pure masses. We have considerable good stoping ground remaining, and if the bottom level (27th) opens up as expected we shall be in good condition for the ensuing year. On the whole, I should consider the prospects for this year good, if we could realize a reasonable price for copper, say 11 or 12 cents.

CONSTRUCTION.

We have done considerable construction work the past year. We have built a new stone engine house, 60x60 feet, with a very heavy and strong foundation for our new hoisting machinery, and we are now putting the same in place. I expect to have the new engines in operation about the first of May. We have built a rock cistern back of No. 4 shaft, 8 feet deep, 18 feet wide and 48 feet long, which will not only give us a reserve of water for feed water and fire purposes in dry times, but gives us a head of water 180 feet high. In the mine we have put in a six-inch plunger pump at the 27th level, and have renewed the skip road in No. 2 shaft by putting in 30 pound steel rails. We have also done a large amount of repairing in the inclined shaft. Considerable has also been done in the way of repairing and painting our dwelling houses, which was much needed.

Table showing product of Central Mine—refined copper :

Years.	Tons.	Pounds.	Years.	Tons.	Pounds.
1856.....	32	403	1872.....	623	56
1857.....			1873.....	751	1,117
1858.....	71	1,011	1874.....	870	900
1859.....	84	312	1875.....	733	952
1860.....	125	1,370	1876.....	1,080	1,400
1861.....	70	139	1877.....	997	1,640
1862.....	133	1,972	1878.....	945	1,013
1863.....	278	1,548	1879.....	899	1,495
1864.....	381	1,855	1880.....	1,013	78
1865.....	346	1,200	1881.....	709	465
1866.....	574	1,842	1882.....	676	1,595
1867.....	687	745	1883.....	634	556
1868.....	1,353	1,827	1884.....	723	747
1869.....	903	1,801	1885.....	1,078	1,408
1870.....	663	1,156	1886.....	1,256	886
1871.....	716	662			
Total.....				19,447	1,173

John Dunstan, Agent; Samuel Bennett, Mining Captain; J. F. Robert, Clerk.

THE ST. CLAIR COPPER COMPANY

is not operating. The mine is idle, and the financial affairs of the company are in bad shape. Most of the stock was held by men in the copper region who had faith in the mine and furnished the money. The loss falls somewhat severely on some of them. The mine and the finances were no doubt badly managed. By referring to former reports, a full description of the mine will be found. The map, however, is included here.

THE COPPER FALLS MINE

is one in which a good deal of interest has been taken for many years. It is situated in the north slope of the range, north of the Central, and was early a fissure vein mine, which produced richly of mass copper. The map herewith given shows the section of old Owl creek fissure vein mine, but it is now chiefly used as an entrance to the ash bed, the belt in which all this mining work is done.

The vein crosses the formation nearly north and south, and the so-called ash bed extends east and west, dipping north at an angle of about 28° , and having a width of about seven feet. It is a soft amygdaloid rock yielding, the portion which is mined and treated, about 7-10 of one per cent of copper. The drawbacks to the Copper Falls mine are want of richness of the rock, narrowness of the belt, and the low angle at which it dips. These are so great that, while the copper is produced with great cheapness, it is still, under the circumstances, with the low price of copper now prevailing, nearly impossible to operate the mine at a profit.

For some years past the company has mined exclusively west of the vein, and the workings extend an extreme distance in this direction of about 1,400 feet, and is opened in depth to the fourteenth level, five levels below the adit, the avenue through which all the copper finds its way out of the mine.

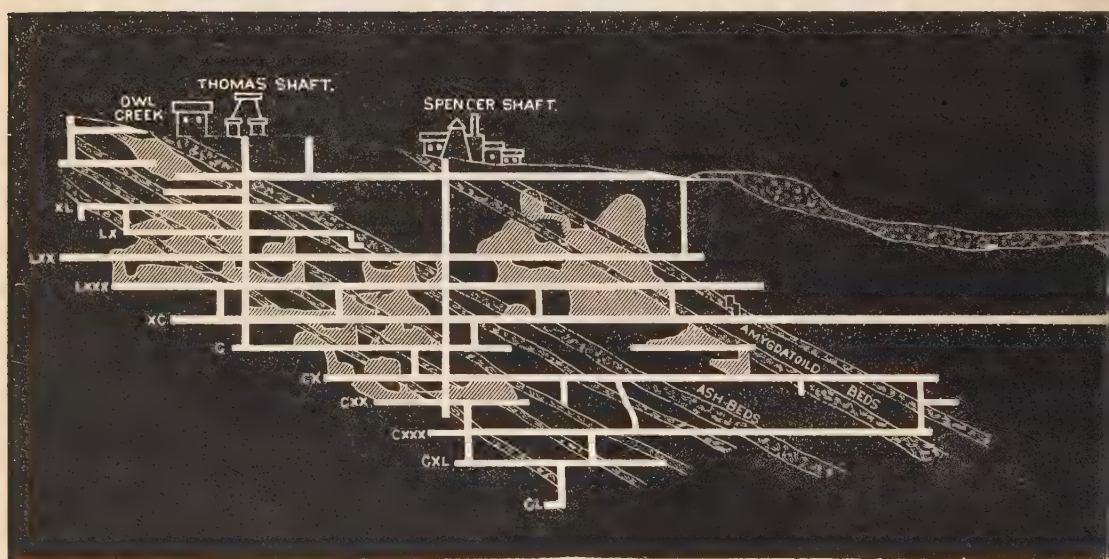
The method by which the mine is worked is fully explained in my last report, and there has been no change, except that now much of the rock is brought down from the stopes in cars, which run on suspended wire ropes. They are so arranged that two of these tracks, each running to a different shute, extend from the same stope, or are connected so as to operate together. On the one the loaded car going down, draws up an empty car on the other. This arrangement facilitates getting the dirt down the foot wall very materially. I watched the working of it, and saw no hitch or delay in the movements.

I have been through the mine almost annually for the past seven or eight years, and I never saw it look better than it does now. It is more extensively opened than I have ever found it before, and it seems that there is more rich ground; but perhaps this is only an impression that one receives on account of seeing more of it. Between the underground shafts Nos. 1 and 2, all the way is good ground. The bottom, the thirteenth and fourteenth levels, look well. I never saw better ground in the ash bed.

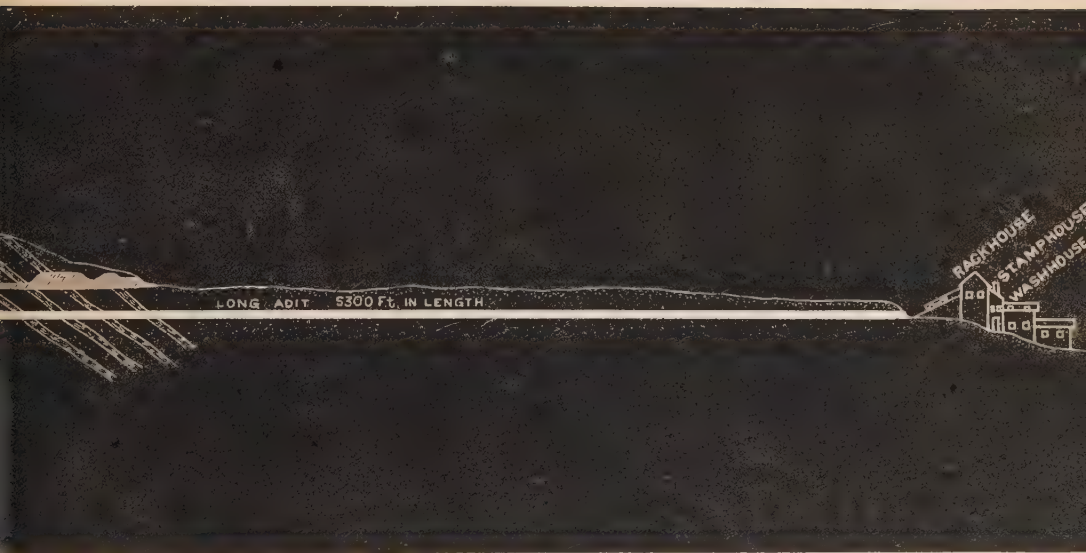
Capt. Moyle's plan is to get the mine largely opened, so there shall be stoping ground sufficient to enable them to operate four heads of stamps. The mill has been enlarged, and provided with two new stamp heads, the improved Bell, that are second to none in the country. These two large heads are the only ones now operated. They will stamp 450 tons per day. The rock is yielding 17 lbs of copper to the ton. In 1885 the average yield was but 13 lbs. Capt.

LONGITUDINAL SECTION OF THE COPPER FALLS

Scale, 5



NE THROUGH THE OWL CREEK VEIN, JAN., 18-7.
one inch.



Moyle thinks he can furnish equally good rock in quantity sufficient for the four heads.

The former agent, Mr. B. F. Emerson, long and favorably known in the copper region, met with a fatal injury at the mine in August last, and he has been succeeded by Capt. J. H. Moyle, who has been in charge since October, 1886. Capt. Moyle was mining captain at the Copper Falls ten years ago, so that he is only returning to familiar ground.

The total expenditures to date have been ----- \$3,047,823

The total mining expenses for the year 1886 were ----- 113,534 73

The total number of tons of rock stamped were 122,410; the
total stamp mill expenses were ----- 38,979 23

Making the stamp mill cost per ton of rock ----- 3 18

This is certainly very low, considering that the water has all to be pumped, the cost of which work is five cents per ton.

Since I visited the mine it has been decided to shut down the mill, and the company is only doing opening work in the mine.

The officers of the company are the same as heretofore, with the exception of the local agent, who is now J. H. Moyle.

President, David Nevins, 19 Exchange Place, Boston.

The mind has yielded as follows:

Years.	Tons.	Pounds.	Years.	Tons.	Pounds.
Previous to 1855.....	158	-----			
1855.....	100	-----	1871.....	239	883
1856.....	104	10	1872.....	260	862
1857.....	153	1,305	1873.....	643	540
1858.....	151	1,852	1874.....	535	359
1859.....	173	174	1875.....	203	1,587
1860.....	255	818	1876.....	8	1,488
1861.....	280	11	1877.....	5	1,950
1862.....	299	299	1878.....	5	1,790
1863.....	159	1,348	1879.....		-----
1864.....	179	808	1880.....	3	645
1865.....	235	-----	1881.....	334	1,121
1866.....	568	1,169	1882.....	293	1,500
1867.....	1,128	1,485	1883.....	402	-----
1868.....	239	1,384	1884.....	445	1,168
1869.....	345	1,406	1885.....	575	538
1870.....	386	990	1886.....	689	679
Total.....				9,495	133

THE PHOENIX COPPER COMPANY

has ceased to operate. The mine has passed to the ownership of the bondholders. Mr. J. H. Chandler, of Houghton, Michigan, is the agent of the present owners. There is no reason to rate the property any lower now than heretofore. It has undoubtedly been unfortunately managed.

The mine has not been worked for a year on company account. Some copper is obtained by tributers. In previous reports I have fully described the mine and all matters pertaining to its previous record. No doubt the mine will at some time be again in a prosperous condition.

The following table shows the product:

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
Previous to 1855.....	19	.....	1871.....	609	1,802
1855.....	3	.....	1872.....	364	420
1856.....	8	.....	1873.....	260	1,080
1857.....	17	.....	1874.....	649	400
1858.....	.....	.....	1875.....	702	276
1859.....	23	590	1876.....	698	530
1860.....	20	62	1877.....	511	493
1861.....	34	790	1878.....	150	1,172
1862.....	31	1,590	1879.....	272	1,436
1863.....	72	118	1880.....	218	10
1864.....	142	187	1881.....	204	1,357
1865.....	202	1,000	1882.....	268	1,177
1866.....	206	.....	1883.....	256	291
1867.....	155	115	1884.....	310	1,004
1868.....	130	.....	1885.....	180	1,108
1869.....	398	990	1886.....	50	1,804
1870.....	499	1,040			
Total.....				7,724	542

THE CLIFF COPPER MINING CO.

The mine is not worked, but a couple of gentlemen who are familiar with the situation have secured a quantity of wood with the intention of running the stamp mill and washers on the waste sands at the mine. They have found by testing the matter that these tailings hold a sufficient amount of copper to pay for re-washing.

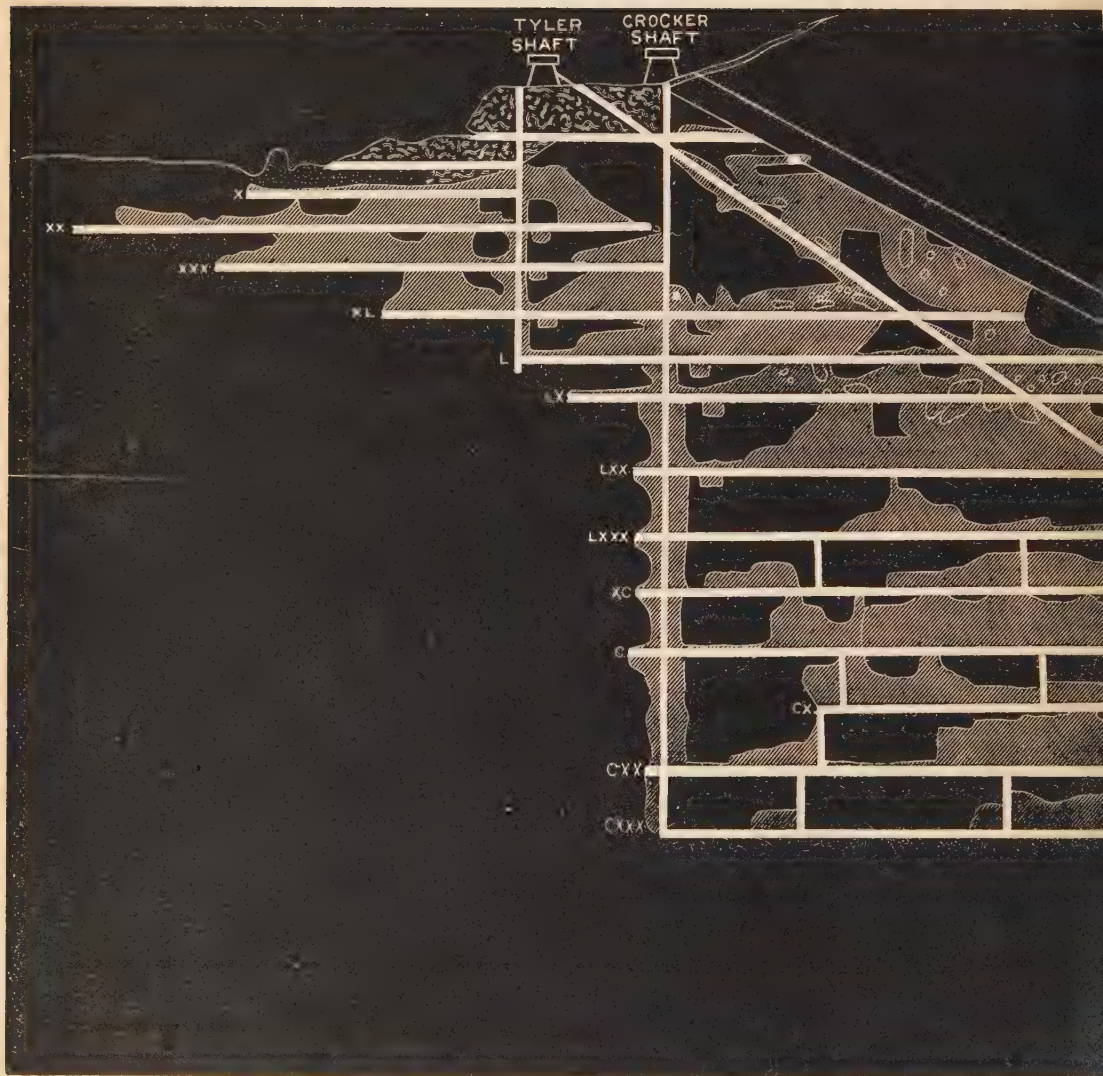
But owing to the continued low price of copper this plan has not been pursued and the mine is idle.

[illegible]

Scale, 600 ft. to one inch.



LONGITUDINAL SECTION
Scale, 3



THE PHOENIX MINE, 1887.
one inch.



The Cliff has produced as follows :

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
Prior to 1855	3,400				
1855	937	197	1871	71	238
1856	1,110	934	1872	59	386
1857	1,118	850	1873	357	1,203
1858	1,130	433	1874	527	901
1859	707	1,007	1875	581	873
1860	921	1,303	1876	450	146
1861	964	11	1877	80	1,319
1862	1,002	960	1878	207	415
1863	1,050	354	1879	67	336
1864	675	1,334	1880	30	962
1865	747	626	1881	39	1,382
1866	821	428	1882	33	53
1867	560	1,725	1883	5	374
1868	613	746	1884	14	255
1869	362	1,247	1885	4	332
1870	222	381	1886	11	342
Total				19,064	1,643

D. D. Brockway, Agt., Phoenix, Mich.

THE ALLOUEZ MINE

is still worked on tribute by Messrs. Watson & Wall, though they do not find the profit sufficiently great to induce them to push things very much. On the contrary the tendency is to circumscribe the operations. They have recently ceased to hoist in No. 1 and in No. 3 shafts, and in the ensuing year they will only stoep in the vicinity of No. 2. shaft.

Last summer the stock took a slight boom, owing to the finding of some rich ground in the 16th level, 250 feet from No. 2 shaft. It was rumored that they had found the Calumet and Hecla lode. The ground did not hold rich going up, but the indications seem to afford assurance that this rich "shoot of copper" will continue on down.

Mr. Fred Smith, the company's gentlemanly and efficient agent, continues to reside at the mine and superintend the affairs of the corporation.

The force employed consists of 36 miners, 36 trammers, 8 block holers, 3 timbermen and 3 helpers; 9 power drills are operated. The mine has been fully described in previous reports.

ALLOUEZ MINE REPORT.

The directors present the following summary of the operations at the mine, and of the business of the company during the year 1886.

The lessees of the mines stamped 116,612 tons of rock, which yielded 1,725,463 pounds refined copper, or an average yield of 14 3-10 pounds per ton of rock stamped. The royalty received by the company was one-tenth of the copper produced, or 172,545 pounds ingot copper, and the following statement shows the receipts and expenditures for the year:

RECEIPTS.

Copper sold.....	125,973 lbs. average 10.93 cents.....	\$13,776 74
Copper in New York and at smelting works.....	46,572 lbs. valued at 10c. net.....	4,667 20
	172,545 lbs.	\$18,433 94
Interest account.....		464 65
		<u>\$18,898 59</u>

EXPENDITURE.

At Mine.

Taxes on personal property.....	\$273 83
Insurance on buildings and machinery.....	1,447 50
Surveying mine.....	31 00
Canal tolls on copper.....	12 48
Copper barrels.....	268 80
Legal expenses.....	150 00
Agent's salary and other expenses.....	1,706 10
	<u>\$3,889 71</u>

In New York.

Freight and other charges on copper.....	\$704 18
New York State tax.....	12 00
Office and other expenses.....	1,150 68
	<u>1,866 86</u>
Total running expenses.....	<u>\$5,756 57</u>

Add other payments, viz.:

State of Michigan, tax on copper of 1885, due July, 1886.....	393 95
St. Mary's Mineral Land Co., in final settlement of claim for trespass pending for several years.....	849 84
Machinery account, paid for Knowles' pump.....	375 00
Rent of water privileges for 1885.....	265 00
	<u>\$7,640 36</u>
Net gain in 1886.....	\$11,258 23
Add balance of assets, December 31, 1885.....	48,612 66
Net surplus, December 31, 1886.....	<u>\$59,870 8</u>

STATEMENT OF ASSETS AND LIABILITIES, DECEMBER 31, 1886.

Assets.

Cash in bank.....	\$6,337 64
Deposits in trust companies.....	30,000 00
Copper on hand, 46,572 lbs., at 10 cents net.....	4,657 20
Accounts receivable.....	916 23

\$41,911 07

At Mine.

Cash in bank.....	\$1,090 75
Supplies.....	9,192 81
Standing wood and timber, not on company's lands.....	7,602 68
Accounts receivable.....	168 07

18,054 41

\$59,963 48

Liabilities.

Accounts payable.....	92 59
Net surplus.....	\$59,870 89

By order of the directors,

JOHN STANTON, *Treasurer.*

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1869.....	1	1,575	1880.....	658	471
1873.....	10	1,163	1881.....	736	1,007
1874.....	504	130	1882.....	841	1,557
1875.....	692	1,574	1883.....	875	1,337
1876.....	780	1,785	1884.....	964	174
1877.....	650	479	1885.....	1,085	476
1878.....	565	1,146	1886.....	862	1,468
1879.....	715	1,452			
Total.....				9,946	1,723

KEARSARGE MINING COMPANY.

The company has existed for some years, but until the past year has never done much work. A few years ago some parties had the mine on option, but finally gave it up after working a while. The mine is just north of the Wolverine, in the S. $\frac{1}{2}$ Sec. 6, T. 56 N., Range 32. In point of fact, the company owns here a rectangular area, consisting of 520 acres, $1\frac{3}{4}$ miles east and west, and one half mile north and south.

The Kearsarge amygdaloid, in which the exploring is done, is an irregular, pockety, epidote lode. There are two shafts, 400 feet apart, which have been sunk to the third level, and are connected in the second. No. 1 shaft is now, March 1, 350 feet deep, and No. 2 shaft is 300 feet.

The levels are 100 feet apart, after the first one, which is, at No. 1 shaft, 150 feet below the surface, and at No. 2 shaft 100 feet, there being fifty feet difference in surface level at the shafts.

The stock is divided into 50,000 shares, par value \$25.

The work done in past year is shown by following financial statement:

Sunk No. 1 shaft 220 feet, at cost of \$11.65	\$2,563 85
Sunk No. 2 shaft 191 at cost of \$12.64	2,356 15
Total	\$4,920 00
Total amount drifting 216 feet, cost	1,621 20
Total amount forks cut, cost	179 00
Total	\$6,720 25
No. of days worked, 2,137; average No. of men, 12.	
Sinking 41' shaft, cost	\$11.71 per foot.
Drifting 231 1-10 feet, cost	7.00 per foot.
Total days, 5,417; average men per month, 26.	
Overseer	\$248 00
Surveyor	208 45
Smith, machinist, carpenters	824 86
Engineers	987 15
Timbermen	1,091 27
Landers, laborers, teamsters, etc.	1,957 78
	\$5,319 51
No. days worked, 3,280.	
Supplies	4 452 03
Total	\$16,267 69
Less sundry credits	29 50
Making net total	16,462 79
Surface expenses, net total	2,721 29
Total No. of days 1,037; average No. men per month, 5.	
Incidental expenses, total	745 12
Total number of days' work, 208; average number of men, 1.	
Construction account, total cost	13,902 21
Total days, 2,010; average No. men per month, 10.	
Total running expenses—mining and construction. Mining expense, days, 5,417	\$16,462 79
Surface expense, days, 1,037	27,212 29
Incidental expense, days, 208	745 12
Construction, days, 2,010	13,902 21
Total	\$33,831 41
No. of days, 8,672; average No. men per month, 39.	
Supply account: Purchased	16,290 04
Labor	83 42
Credits	13,836 61
Balance	2,336 85
Fuel	1,999 49
Treasurer's account: By drafts	29,866 27
Received from treasurer	29,866 27
Received from other sources	1,718 58
	\$31,564 85

Mr. Frank Klepteko, the company's engineer, tells me that the distance from No. 3 pit, measured at right angles to the Kearsarge lode, to the Calumet and Hecla Conglomerate, is 2,850 feet west.

J. W. Clark, President; John Daniel, Agent; Capt. Haskins, Supt.

THE WOLVERINE MINING CO.

The Wolverine mine was worked on tribute for two years after the failure of the company by Messrs. Funkey & Wilcox. At present, however, the mine is wholly idle. The question of the title to the land is in dispute and the legal ownership is yet to be determined.

John Wall, Allouez, Mich., now exercises control of the property.

The mine was opened in 1883 and has yielded a total of 989 tons, 1,378 lbs.

THE CENTENNIAL MINING CO.

The Centennial mine, although idle, is a property regarded with considerable interest because of its situation. It joins the Calumet & Hecla on the north and the ground in the bottom of the Calumet shaft nearest to the boundary is proving rich in copper, suggesting the possibility that the same "shoot," or others north of it, may be found under the surface at the Centennial. The company owns in fee the S. $\frac{1}{2}$ of Sec. 12, 56, 33, and has an option for the purchase of the N. $\frac{1}{2}$, thus making a mile square. The property is crossed by all the prominent lodes in the country and there is pretty good evidence to assume that they here possess richness enough to at least pay well for working. Provided with the facilities that other larger mines now have and worked on the same extensive plan, the Centennial would show favorable results.

The original company was organized in 1863 and opened in the Calumet & Hecla conglomerate. Several shafts were sunk, No. 2 to 2d level, No. 3 shaft to the 4th level, No. 5 to 4th level and No. 1 only to the ledge.

The ground between Nos. 3 and 4 shafts was nearly all stoped out, and in the second level, 400 feet N. of No. 4 shaft, good copper ground was found, it is said. These shafts are 650 feet apart, No. 4 being north of the others.

Judging from the map there appears to be a shoot of copper starting at No. 3 shaft, near the top, and at the bottom is 200 feet north of the shaft. The shoot has a lateral dimension in the direction of the strike of the lode of 300 feet, No. 3 shaft is 430 feet deep and No. 4 500. The rock at the burrows shows the character of the conglomerate of which more is known now than when the Schoolcraft was worked 20 years ago. A test pit was sunk 350 feet north of No. 4 shaft, into the ground. It is said a good showing of copper was found, but they were driven out by the excess of water. Also the drift in the second level from No. 4 shaft goes under this and the ground was found to be good.

Capt. Hall's plan is to sink No. 3 shaft to an indefinite depth and explore the ground. The hope would be to cut some shoots or pockets of conglomerate that are rich in copper.

More recently some work was done in the Osceola amygdaloid, two shafts were sunk 650 ft. apart and No. 1, the north shaft, 200 feet to the second level. No. 2 was sunk 500 feet to the fifth level. The shafts were connected in the second level.

In the third level they drifted north 300 feet and south 200 feet. In the fourth level in No. 2 the drift north is 150 feet and south 100 feet. The best ground was found in the vicinity of No. 1.

I saw this ground when they were working in it in 1881 and thought it as good as the Osceola.

The Osceola amygdaloid is 802 feet east of the conglomerate, surface measurement. At the Osceola mine the distance between the belts is 760 feet. Distance between the Allouez and the Calumet and Hecla Conglomerates is 2,125 to 2,140 feet varying at different points.

At the mine is good machinery, hoisting engines, etc., also a Rand's duplex compressor of same size as in use at Osceola. The company has all the machinery requisite for a thorough exploration of the property.

President, S. L. Smith, Lansing, Mich.; Josiah Hall, Supt., Calumet, Mich.

THE CALUMET & HECLA CO.

is constantly increasing its facilities for enlarging its out-put of copper. At present more is doing in this direction than at any period heretofore. The company is prepared to hoist far more rock than formerly and the capacity of the stamp mills has been increased in the requisite degree to dispose of the additional rock. The stamps are all now Leavitt heads, seven in the Hecla mill and five in the Calumet; three more are to be added in 1887, which will make 15 in all. The gravity incline at the stamp mills has been done away with and the railroad tracks run now to the rock bins. The bins have been sufficiently elevated to secure automatic feed to the stamps. The grade from the mill up is 185 feet to the mile. The line describes a letter S. Two additional locomotives have been supplied to work on this grade, they weigh respectively 55 and 60 tons on the driving wheels, 90 tons including tender. The boilers—new steel boilers—to supply the steam for all the machinery at the stamp mills are all in the new stone boiler house.

The smelting works, situated about a mile from the stamp mills, are nearly completed. The buildings are of stone, brick and iron as well as wood, and are of the most substantial character. The arrangements are admirable for doing the smelting work economically and expeditiously. There is nothing of the kind in the country better for such work than the facilities they have for storing and unloading coal. The coal is elevated from the holds of the vessels up to

the cars on the tracks that extend into the building. The cars work automatically; in fact it is known as Hunt's automatic railway—Hunt's automatic system for unloading coal vessels. These smelting works are designed to be equal to the present product of the mine and more furnaces will be added as occasion requires.

At the mine the company has been trimming and enlarging the shafts with the view of using larger skips. At the time of my visit to the mine these new skips had already arrived; they hold six tons of rock each, when trimmed. They will not dump at the shaft but will be run to the rock house before discharging the contents. A new rock house will be built the coming year. At the Hecla mine two of the shafts will soon be provided, each with a separate hoisting plant that will bring the skips from the bottom at greater speed than is now done.

The Hecla hoisting engine will be used in driving air compressors. It is contemplated that possibly the plan of erecting a separate hoisting plant at each shaft may be adopted for all the shafts of the mine; in which case the "Superior"—the great hoisting engine on the Calumet side, will be used to drive air compressors. It will not be removed from its present location.

They are hoisting now from 11 shafts, the two deepest of which are to the 38th level; the others are at from the 33d to the 37th, except the two South Hecla shafts, which are down one to the 11th and the other to the 12th level. No. 12 shaft—a new one—is at the 9th level.

They now leave pillars on each side of the shafts in each level 50 feet long. Capt. Hoatson is of the opinion that the shaft pillars heretofore left, of 25 feet long, are insufficient; as the ground settles, the shafts grow smaller and have to be trimmed.

The lode is from six feet to 18 feet wide and has a bad hanging wall, much of it, and has to be kept in place with timbers. They are now using short sets instead of long round stall timbers. The former are more easily handled.

The company employs underground an average of 1,100 men and a total force of 2,600.

The No. of tons of rock stamped in 1886 was 598,522 tons.

No. of tons of barrel work, i. e., of copper not run through the stamps, 602½ tons.

In this connection the following table is of interest:

Year.	Tons of Rock Stamped.	Yield Per Cent. of Ingot Cop-per.	Year.	Tons of Rock Stamped.	Yields Per Cent of Ingot Cop-per.
1875.....	249,704	4.3	1881.....	340,080	4.61
1876.....	259,935	4.37	1882.....	344,132	4.59
1877.....	247,985	4.55	1883.....	372,570	4.45
1878.....	271,000	4.66	1884.....	435,352	4.63
1879.....	284,715	4.61	1885.....	535,820	4.32
1880.....	334,343	4.75	1886.....	598,522	4.22

The company returned to the shareholders in 1886 \$15 per share, making a total to date of \$30,050,000.

Table of product of Calumet & Hecla mine :

Year.	Tons.	Pounds	Year.	Tons.	Pounds.
1867.....	657	1,173	1877.....	11,284	468
1868.....	2,549	375	1878.....	12,625	1,128
1869.....	6,157	1,771	1879.....	13,135	943
1870.....	7,030	1,584	1880.....	15,837	1,239
1871.....	8,111	590	1881.....	15,680	781
1872.....	8,081	183	1882.....	16,026	1,528
1873.....	9,424	265	1883.....	16,562	1,045
1874.....	10,062	1,225	1884.....	20,236	1,585
1875.....	10,736	1,954	1885.....	23,623	1,990
1876.....	10,845	732	1886.....	25,259	220
Total.....				243,948	1,437

Mr. J. N. Wright, General Superintendent, Calumet, Mich. ; Alex. Agassiz, President, Boston, Mass.

THE TAMARACK MINING COMPANY

gives continued evidence of progressive mining spirit. The No. 2 shaft has been located and is already several hundred feet in depth on its way down into the earth. The third section of No. 1 shaft has been completed, provided with a cage that goes to the bottom, and with a separate hoisting plant to operate it, which is placed in a brick building, standing at some distance from the other engine house. It is called the emigrant cage, and is used exclusively for men and for timber.

The railroad is fully completed and operated, and the new stamp mill is also finished and ready to operate. It is not far from the Osceola mill, and is, as would be naturally inferred, one of the best in the region.

LONGITUDINAL SECTION OF THE TAMARACK MINE, JAN., 1887.

Scale 300 ft. to one inch.



There are two heads of stamps now, with place for the third. They are similar to the new heads at Copper Falls mine, and cost each in Milwaukee, \$5,600. The two have a capacity of 450 tons of rock per day; 18" cylinders. Outside, the foundations are laid for two more heads, five in all, when the mine is sufficiently opened to furnish the rock, 1,000 tons per day.

In the Tamarack mill, as also in the Osceola, the railroad track passes through, and is connected with the main line both ways. There is sand room in the lake, it is estimated, sufficient for 14 years, 1,000 tons per day.

More recently the company, or the same gentlemen who control the Tamarack and Osceola companies, have begun the task of erecting smelting works, also on Torch Lake, not far from the stamp mills.

The mine underground is shown on the accompanying plan. In going through it I find it dry and airy. There is a no more comfortable mine in the country to work in than the Tamarack. There are no evidences of "shoots." There is good ground and poor all through the mine; but very little if any, however, that would be designated as valueless. Some portions of rock are rejected in the rock house, and some sandstone, also, occurring in the deposit, is broken down with the good rock, but is sorted out and left in the mine.

The dip is about 38° . No. 1 shaft is now, April 1, 2,495 feet deep, and No. 2 is 490 feet. The levels are not the same distance apart, but average 82 feet on the lay of the deposit. The collar of No. 1 is 640 feet above Lake Superior. From the bottom of the shaft to the seventh level is 333 feet, and the vertical distance is 205 feet, giving for the angle a dip of $37\frac{1}{2}^{\circ}$. No. 2 will intersect the lode at about the eighth level, when they will have a working length of lode of 1,340 feet. The first level is 215 feet long; second, 210 feet; third, 575 feet; fourth, 725 feet; fifth, 865 feet; sixth, 1,020 feet; seventh, 1,170 feet.

They operate 17 to 19 drills now. The compressor has a capacity of 30. The machinery for No. 3 cage is a Corliss engine, conical drum, 10 feet diameter at small end, and 18' diameter at large end; holds 350 feet of rope.

The following is from the Director's report:

We have proved that our lode is identical with the Calumet and Hecla, in all respects, and on the whole, as rich.

We have demonstrated the fact that depth is no hindrance to cheap mining. On the contrary, we have shown from the result of steady work day in and day out for months, that more than five times the amount of rock can be hoisted through a vertical shaft than through one of like dimensions sunk on the plane of a lode, as is the custom of copper mining elsewhere on Lake Superior. This result would not have been accomplished had not our machinery and appliances been of the very best.

Our openings on the lode are still very limited, and can be extended to meet our wants only by almost unlimited patience and energy, for it will be readily seen that our opportunities for the speedy opening up and development of the lode are necessarily

restricted, for the reason of having but one shaft from which to run our levels and cross-cuts.

It will be remembered that the *surface* of our productive property is over 2,200 feet in the bowels of the earth, with only a single opening to the light of day.

Proving the productiveness of the Calumet and Hecla lode to this great depth, gives it a value almost beyond computation, contingent only, it would seem, on the future value of copper. On this point we shall have no misgivings while the present extended use and consequent increased consumption all over the world continue. It will not be forgotten or overlooked by our stockholders that this vast inheritance falls ultimately into the possession of Tamarack, for surely and legitimately every one of the eleven northern shafts of the Calumet and Hecla mine falls by its natural inclination or "dip," into our property, and it is a well known geological fact that every lode or bed, whether conglomerate amygdaloid, or anything else, follows this universal law of "dip." We have met a good deal of hostility, and have overcome obstacles which have cost considerable money and delay, but perhaps not more than was to be expected in an enterprise which, if successfully accomplished, could not fail to have an important influence and bearing on the future of our neighbors.

On reviewing our work from the start, it would be difficult to point out serious error in judgment. We believe our work has been accomplished as expeditiously as due regard to economy would warrant. The treasurer's account will show our financial condition.

It would probably have been wiser to have called an assessment last autumn, thus adding, say \$200,000, to our active capital. That this sum, and more, would be needed to cover the cost of the new mill with the heavy machinery and mining equipment to put it in operation, was as well known then as it is to-day. To re-imburse for these heavy outlays from current production of copper at present reduced prices, was a trial of strength never before put upon any similar enterprise on the lake, or elsewhere, as far as we have been informed.

A considerable advance in ingot copper was anticipated, but instead of this we have had to meet the most serious decline that has been known for many years, reducing the price both here and in Europe to less than ten cents a pound, the lowest quotations ever recorded in the history of copper mining. Still, we are firmly of the opinion that the results of this radical change will not prove wholly disastrous in the future. The price of copper, like coffee or other merchandise, will be governed by quotations from the leading markets of the world, and as soon as we, in the United States, become the largest consumers, as we are already the greatest producers, then by fair reasoning we may expect that New York, and not London, will lead in giving quotations for the various markets of the world. Under our heavy tariff of four cents a pound, we have made our domestic consumer pay two or three cents more than his foreign competitor. The effect and influence of our tariff will not be so largely felt in the future while we continue to be large exporters and not importers. Lake Superior, it is well known, is the best copper produced. It is worth, to-day, in Liverpool or in France, fully four pounds sterling a ton more than Chile bars, which are the recognized standard for quotations.

ASSETS AND LIABILITIES.

Cash in bank at Boston.....	\$3,977 02
Suspense account—stamp mill site.....	833 80
Hancock & Calumet R. R. Co. 6 per cent bonds.....	57,000 00
Assessment No. 1.....	108 00
Supplies on hand at mine.....	28,883 87

Cash on hand at mine.....	169 23	
Accounts receivable at mine.....	564 17	
Wood and timber land.....	14,832 00	
Balance due on 350 shares H. & C. R. stock.....	28,000 00	
Copper on hand, 1,900,571 pounds, at 10 cents.....	190,217 10	
Total cash assets.....		\$324,584 19
<i>Liabilities.</i>		
Drafts outstanding.....	\$28,427 70	
Accounts payable at mine.....	52,356 95	
Bills payable.....	108,200 00	
Loan account.....	35,000 00	
Total liabilities.....		223,984 65
Balance of cash assets July 1, 1886.....		\$100,599 54

STATEMENT OF RECEIPTS AND EXPENSES OF ALL KINDS, 1882 TO JULY 1, 1886.

<i>Receipts.</i>		
From capital stock, 50,000 shares, \$18 a share paid in.....		\$650,000 00
“ 363 lbs. copper produced 1882, at 18.....	\$65 34	
“ 7,435 “ “ “ 1883, at 14.71.....	1,093 37	
“ 1,979,400 “ “ “ 1885-6, at 10.05.....	1,98,944 56	
From 1,987,198 lbs. copper produced at mine.....		200,103 27
From interest receipts, 1882.....	\$832 83	
“ “ “ 1883.....	592 44	
“ “ “ 1884.....	1,656 19	
“ “ “ 1885 (6 months).....	506 92	
“ “ “ 1885-6.....	2,581 12	
From 350 shares Calumet R. R. Co.'s stock.....		6,169 50
		35,000 00
Total receipts.....		\$851,272 77
<i>Expenses.</i>		
Running expenses prior to July 1, 1885.....	\$147,574 62	
Running expenses during 1885-6.....	160,464 94	
		\$308,039 56
Construction expenses prior to July 1, 1885.....	56,761 03	
Construction expenses during 1885-6.....	95,872 64	152,633 67
Real estate.....		330,000 00
Total expenses.....		790,673 23
Balance of receipts July 1, 1886.....		\$100,599 54

DETAILS OF MINING EXPENSE.

<i>Underground Expense</i>		
Shaft sinking, 85.10 feet at \$45.67.....	\$3,887 09	
Winze sinking, 404.20 feet at \$12.90.....	5,217 70	
Drifts, 976.14 feet at \$10.33.....	10,090 06	
Cross-cuts, 237.20 feet at \$8.23.....	1,953 12	
Stoping, 1,822.46 feet at \$13.32.....	24,372 95	
Tramming.....	7,022 86	
Timbering, labor, materials and supplies.....	14,074 13	
Extra work.....	2,259 51	
Supplies, labor, fuel, etc., for air drills.....	10,499 62	
Supplies, fuel, and labor for engines.....	12,972 64	
Mining superintendence and company account labor.....	8,077 27	
Blacksmith, machinist, and carpenter labor.....	2,831 64	
	\$103,258 59	
Less profit on supplies.....	7,257 90	\$96,000 69

They push the work at the Osceola and keep the mine well in advance of all demands that can be made upon it.

There is no better place to study good mining work than at the Osceola. It is noted for clear headed, progressive, energetic management.

The stock of the Osceola took an astonishing rise in the summer of 1886, going up from about \$14 per share to \$32, and remaining at about \$28 to \$30, which price it still holds now with copper at 10c. per lb.

This rise is due to a possible result in the conglomerate. It was found that in the South Hecla—Black Hills—mine the drifts south in the direction of the Osceola were proving rich in copper. This is below the depth at which the conglomerate was worked in the Osceola mine.

To determine whether the Osceola holds any further mineral wealth in the Calumet and Hecla conglomerate a drift has been started to intersect it from the amygdaloid mine.

The location of this drift is from the 16th level, south of No. 2 shaft, 1,450 feet below the surface on the lay of the formation, or 525 feet below the deepest point in the old workings. Its length will be 775 feet.

The distance from the point where this cross-cut will cut the conglomerate to No. 3 conglomerate shaft is 550 feet.

In the old conglomerate mine, the first mine worked in the Osceola, are three shafts, intact.

No. 12 shaft of the Calumet & Hecla is down to the 11th level and they have gone south to within a few hundred feet of the Osceola boundary. The copper holds good so that it is deemed to be strongly probable that this copper ground continues into the Osceola. The cross-cut will be completed in August of the present year.

I have described the mine so fully in previous reports that it could not be otherwise than repetition to enter into a more lengthy statement here. Capt. Daniell kindly gave me leave of copying from the company's report all the items I wished, and I have availed myself so far of the privilege as to extract all that is not embraced in the company's printed report.

OSCEOLA MINE REPORT.

The directors present the following report of the operations for the past year, and statement of the financial condition of the company :

The product of mineral was 4,133,345 pounds, which at 86.14 per cent, gave 3,560,786 pounds of refined copper, for which has been realized the gross sum of.....	\$374,144 13
From interest receipts.....	206 01
From sale of building lots at Hancock	240 00
From sales of silver.....	1,308 93
	<hr/> \$375,899 07

The costs have been:—

Running expenses at mine.....	\$282,068 44	
Smelting, transportation, and all other expenses.....	46,598 19	\$308,666 63
Showing a mining profit of.....		\$67,232 44
There has also been realized from 360 shares of Hancock & Calumet R. R. stock.....		36,000 00
The balance of assets January 1, 1886 was.....	\$102,281 60	
Add 250 shares Hancock & Calumet R. R. stock.....	25,000 00	
	\$127,281 60	
There has been expended in mine plant during the year.....	4,772 05	122,509 55
Making the balance of assets January 1, 1887.....		\$225,741 99

A dividend of \$1 per share, or \$50,000, payable February 15, has been declared from the earnings of the past year.

The superintendent's report, herewith submitted, is regarded by the directors as highly promising. Although the developments during the year show nothing of striking character, a gradual but decided improvement is observed as the shafts and levels are extended and opened up in depth and in the south. While we do not anticipate such results as have been realized in the neighboring conglomerate lodes, we feel assured that there are well grounded reasons for hoping and expecting a better outcome than we have seen in the past few years. Our territory is extensive on the south, and as the best results are realized in that direction, we see no good reason why we may not look for reasonable returns in dividends from the amygdaloid lode, just as it is, with its regular and legitimate extension south and in depth. The mine is more extensively opened and is stronger and richer in its resources than at any former period of its history. The amount of money actually invested in underground openings, while the mill was in process of rebuilding, aggregates nearly \$50,000, and all of it was taken from our surplus fund.

There is little doubt that this is a better investment than if we had the money to our credit in bank to-day.

There was quite a boom on the street in our stock a few months back, growing out of the developments in the neighboring mine, and great results were predicted in the early future. It is to be hoped that these expectations may be realized, but it is obvious that they were largely based on speculation. Reference by Capt. Daniell to this matter in his report will be noticed. The cross-cut from the amygdaloid at 16th level, which is between 700 and 800 feet west of the conglomerate, will reach that lode in about six months, and will expose a section of it some 600 feet greater in depth than has ever been seen on our property, which joins the Calumet and Hecla location, without a break in the conglomerate lode. When it is remembered that we have this lode outcropping for a length of over a mile, without surface indications to show that there may be in the depths below vast deposits and stores of copper waiting to be brought to light by the hand of industry, and when it is considered further that the character of this conglomerate lode is so unique, and has in reality been so comparatively little examined and studied, in the light of more modern science, the possibility of the future can hardly be over estimated.

The directors have never for a moment lost sight of the purpose and object of this exploration by cross-cut. As soon as the mine should attain sufficient depth to promise the best results in time and money, whatever the outcome may be, they would not be justified in longer delaying the work.

We have a most extensive mine, thoroughly and economically opened on the best

scientific mining principles, and, although it must be classed as a lean or low grade mine, it ought to give, and in the long run it is not doubted that it will give, satisfactory returns in dividends, on a valuation of its stock at higher figures than we have seen in the past half dozen years. All this is predicted upon a fair price for ingot copper.

The management may justly take pride in comparing their work with any of their neighboring mines on Lake Superior or elsewhere in this country or abroad.

Our smelting arrangements are not satisfactory. The directors have under consideration a plan by which we ought to be placed in better shape for handling and marketing our product. This subject is regarded by the directors as of the highest importance to the future well-being of the mine.

Assets and Liabilities.

Cash in bank at Boston.....	\$26,133 69
Cash on hand at mine.....	1,253 02
Supplies on hand at mine.....	26,605 15
Fuel on hand at mine and stamp mill.....	33,094 53
Accounts receivable at mine.....	14,599 79
Bills receivable at Boston.....	20,616 10
1,700 acres of land at Dollar Bay, Michigan.....	15,536 87
Hancock & Calumet R. R. Co. 6 per cent bonds.....	38,000 00
Balance due on 360 shares Hancock and Calumet R. R. stock.....	14,400 00
250 shares Hancock and Calumet R. R. stock.....	25,000 00
Copper on hand, 1,187,719 lbs., at 10½ cents.....	124,710 50
Total assets.....	\$339,949 65
<i>Liabilities.</i>	
Drafts outstanding.....	\$34,949 85
Accounts payable at mine.....	30,213 43
Bills payable at Boston.....	45,059 97
Due Laurium Mining Company.....	3,874 16
Dividends uncalled for.....	110 25
Total liabilities.....	\$114,207 66
Balance of assets January 1, 1887.....	\$225,741 99

STATEMENT OF RECEIPTS AND EXPENSES OF ALL KINDS FROM SEPTEMBER 25, 1873, TO JANUARY 1, 1887.

Receipts.

From capital stock, 50,000 shares, \$25 a share full paid.....	\$1,250,000 00
From 936,002 pounds copper, 1874, at 23.37c.....	\$218,736 92
From 1,330,313 pounds copper, 1875, at 22.77c.....	302,862 96
From 1,693,737 pounds copper, 1876, at 20.57c.....	348,333 25
From 2,774,777 pounds copper, 1877, at 18.19c.....	504,636 93
From 2,705,998 pounds copper, 1878, at 15.53c.....	420,340 14
From 3,197,387 pounds copper, 1879, at 17.79c.....	568,689 89
From 3,381,061 pounds copper, 1880, at 19.15c.....	647,487 19
From 4,176,976 pounds copper, 1881, at 17.77c.....	742,585 84
From 4,179,782 pounds copper, 1882, at 17.70c.....	739,458 26
From 4,256,409 pounds copper, 1883, at 14.96c.....	636,846 83
From 4,247,630 pounds copper, 1884, at 12.82c.....	544,651 02
From 1,933,169 pounds copper, 1885, at 10.75c.....	208,558 65
From 3,560,786 pounds copper, 1886, at 10.51c.....	374,144 13
Total, 38,380,027 lbs., at 16.30c.....	\$6,257,332 01
From sales of silver to date.....	32,439 04
From interest receipts to date.....	36,220 87
From 360 shares Hancock & Calumet R. R. stock.....	36,000 00
Total receipts.....	\$7,611,991 92

Expenses.

Running expenses prior to 1886.....	\$4,823,259 10	
Running expenses during 1886.....	308,666 63	
	<hr/>	\$5,130,925 73
Construction expense prior to 1886.....	\$705,062 17	
Construction expense during 1886.....	4,772 05	
	<hr/>	\$709,834 22
Real estate.....		589,036 20
Dividends prior to 1886.....		972,500 00
Exploratory work.....		8,953 78
Total expenses.....		<hr/>
		\$7,411,249 93
Balance of receipts January 1, 1887.....		200,741 99
Add 250 shares Hancock & Calumet R. R. stock.....		25,000 00
Balance of assets January 1, 1887.....		<hr/>
		\$225,741 99

Details of Mining Expense.

Shaft sinking, 418.10 feet, at 12.49.....	\$5,220 84	
Winze sinking, 284.70 feet at 10.37.....	2,951 90	
Drifts, 4,471.55 feet, at 6.55.....	29,269 44	
Cross-cuts, 21.30 feet at \$7.50.....	159 75	
Stoping, 8,996.05 fathoms at \$9.42.....	84,764 10	
Tramming.....	22,065 38	
Timbering, labor, materials and supplies.....	7,021 10	
Extra work.....	832 72	
Supplies, labor, fuel, etc., for air drills.....	23,814 02	
Supplies, fuel and labor for engines.....	29,668 71	
Mining superintendence and company account labor.....	17,083 57	
Blacksmith, machinist and carpenter labor.....	2,557 71	
	<hr/>	\$225,409 24
Less profit on supplies.....	29,924 08	
		<hr/>
		195,485 16

Other Expenses.

Rock-house.....	\$18,391 49	
Surface, labor, supplies, etc.....	1,481 32	
Incidental expenses, including taxes.....	5,214 94	
Office labor, supplies, etc.....	5,561 63	
Transportation.....	21,410 50	
Stamping.....	14,523 40	
	<hr/>	\$66,583 28
Total running expenses.....		<hr/>
		\$262,068 44

Construction Costs.

No. 3 engine plant.....	\$1,356 73	
Fire boxes at mine.....	1,690 55	
Dwelling houses at stamp mill.....	307 77	
Compressor, boiler house, etc.....	857 05	
Houses from John Bagley.....	1,522 15	
School-house at mine.....	4,705 38	
Rock-bin at stamp mill.....	347 99	
Dock at stamp mill.....	392 41	
Transfer of engine from No. 3 to No. 4 shaft.....	75 08	
Stamp mill construction.....	3,756 99	
	<hr/>	\$15,012 05

Credit.

By rock cars sold.....	10,240 00	
	<hr/>	4,772 05
Total expended at mine.....		<hr/>
		\$266,840 49

Summary.

Rock stamped.....	137,725 tons	
Product of mineral.....	4,133,545 lbs.	
Product of refined copper.....	3,560,786 lbs.	
Yield of refined copper per ton of stamped rock.....	25.85 lbs.	
Yield of refined copper per cubic fathom ground broken.....	396 lbs.	
Yield of mineral per cubic fathom of ground broken.....	459 lbs.	
Percentage of mineral in stamp rock.....	1.50 per cent.	
Per centage of refined copper in stamp rock.....	1.29 per cent.	
Cost per ton of rock hoisted.....	\$1 62	
Cost per ton of rock stamped.....	1 90	
Refined copper, cost per pound at mine.....		7.36 cts.
Cost of smelting, freight, and all other expenses.....		1.31 cts.
Total cost per pound of refined copper laid down in New York.....		8.67

SUPERINTENDENT'S REPORT.

OPECHEE, February 1, 1887.

To the President and Directors Osceola Consolidated Mining Company:

GENTLEMEN:—The following report of our operations for the year past, and present conditions of the mine is respectfully submitted.

Work has gone on with much regularity. Stamping for Tamarack mine has restricted our output to some extent, but this cannot be regarded as a disadvantage in any way. The cost of stamping has been reduced on account of keeping the mill fully employed. A profit has been made on the stamping for Tamarack, and we have been enabled to more closely select ground for working.

Rock hoisted from the mine was 161,929 tons, the equivalent of 8,996.05 fathoms of ground; this afforded in all 4,133,545 lbs. of mineral, which, at 86.14 per cent, gave 3,560,786 lbs. of ingot copper.

The mill product was.....	3,808,400 lbs.
Barrel work was.....	326,055 lbs.
	4,133,545 lbs.

Yield of ingot per fathom of ground treated, equals 395.83 lbs., which is 29 lbs. in excess of the previous year. Each ton of rock hoisted afforded 22 lbs. of ingot copper.

The underground operations foot up as follows:

Shafts.....	418.1 feet
Winzes and rises.....	210.2 "
Levels and cross-cuts.....	1,461.8 "
	5,090.1 feet
West amygdaloid winzes.....	74.5
Levels.....	31.0 105.5 feet
Total.....	5,195.6 feet

The sinking in each shaft and present depths, can be gathered from the following:

Shaft.	Sunk.	Depth from Surface.
No. 1.		1,387.1 feet 18 feet under 15th level
" 2.	88.2 feet	1,714.5 " 8 " 19th "
" 3.	154.1 "	1,798.2 " " 20th "
" 4.	175.8 "	1,535.4 " 7 " 17th "

As intimated in the preceding annual report, we have given more attention to the development of the south part of the mine, the ground between Nos. 3 and 4 shafts and south of No. 4 absorbing much of the year's openings. It is satisfactory to note

that better ground has been found in this part of the mine than before, the average being equal, both in length and quality, to what has prevailed in the northern ground. If it has not been proved that the copper ground has a decidedly southern trend, there can be no question as to its improving and lengthening in that direction, as the mine deepens.

The extension of the several levels, for the year, foots up as follows:

4th level, 112.9 feet	16th level, 667.7 feet
11th " 155.1 "	17th " 712.1 "
12th " 501.9 "	18th " 924.5 "
13th " 383.0 "	19th " 701.4 "
15th " 264.9 "	20th " 17.1 "
16th " Cross-cut west.	21.3 "

The sinking of No. 2 shaft has been in the foot wall part of the lode. No copper of consequence was noted until near the 19th level; at and under that level good ground was encountered, and the prospects for deeper sinking are extremely good. In cutting 19th level plat the width of lode exposed was fully 16 feet, and this good copper ground. As no stoping has been done, for the present this width is regarded as exceptional.

The 19th level north of No. 2 shaft, 163.6 feet has opened good stoping ground for the whole length. The 18th level north of No. 2 shaft also proved good for all the distance driven, 150.4 feet. The 17th level has been drifted north of No. 2 shaft 238 feet, the last 175 feet in stoping ground, but so far has proved rather under average.

The 19th level south of No. 2 shaft, drifted 218.9 feet, shows good copper ground for 150 feet from shaft, much longer than was expected, because 18th level, over, was poor for fully 200 feet south of the same shaft, except that in places we found some isolated patches of barrel work.

No. 3 shaft, sunk to the 20th level, has continued in the hanging wall trap. In sinking, the lode has occasionally been pricked into, and has invariably shown good copper ground. The 20th level, opened 17 feet in all, shows a good lode in the north opening, but going south has not yet been seen to any extent.

The 19th level north of No. 3 shaft has been driven 186.6 feet. The first 80 feet shows ground of average quality; later we find harder ground, generally lean, but showing an occasional piece of barrel work. Looks like the ground nearer No. 2 shaft at 18th level, before referred to.

The 18th level, for fully 300 feet north of No. 3 shaft, afforded good stoping ground.

The 19th level south of No. 3 shaft is advanced 132.8 feet; the lode has been somewhat irregular in productiveness, but of very good character. Expect it to afford average quality ground for copper.

The 18th level south of No. 3 shaft extended 278.8 feet; the whole drive here shows stoping ground, some of it quite rich, and altogether of better than average for copper. The 17th level has been holed between Nos. 3 and 4 shafts. No ground opened in the mine has proved more continuously productive than what is exposed here; some of it is quite good, and much of it above average. The 16th and 15th levels between Nos. 3 and 4 shafts have been communicated also.

Extensive stoping has been done near No. 4 shaft in the back of 15th level, and for 200 feet in length the lode has been about 12 feet wide and of full average quality. The 16th level between the shafts, it is expected, will prove better than the 15th, but comparatively little stoping has been done as yet.

In sinking No. 4 shaft from 15th to 16th level, a very good lode was exposed. From 16th to 17th level the shaft passed into the hanging wall trap, and of course shows nothing of value.

The 16th level south of No. 4 shaft has been drifted 123.6 feet wholly in stoping ground. The 15th level south of same shaft has been opened for 215 feet. No stoping has been attempted, but the lode for the whole length indicates better than average quality ground. The 13th level south of No. 4 shaft, drifted 383 feet, gave nothing of special value for 150 feet; the lode then improved and 100 feet in length of good ground was drifted through. Latterly the lode has been bunchy, but stoping ground will probably be found when it is thoroughly tested.

The 12th level south of No. 4 shaft has been drifted 501.9 feet. About 350 feet from shaft good ground was found, and this continued for nearly 150 feet. In stoping the lode has afforded considerable barrel work. Nearer the end of the drivage the lode has been bunchy, but of good character. This opening will be pushed ahead, expecting more ground of value in advance of us.

The 11th level south of No. 4 shaft has been drifted 155.1 feet, and opened copper ground of low quality nearly all the length. The 4th level south of No. 4 shaft has been drifted 112.9 feet. Lode here is of good character, but not good enough to remove at present.

The openings for the year have afforded as much length of copper ground, proportionately, and of as good quality, as in any like period. There is good reason to conclude that the lode in the deeper levels going south will prove as productive as elsewhere in the mine. The intention is to develop in that direction to determine the limits of the copper ground, and the advisability of sinking one of the Opechee shafts.

The sinking of No. 2 shaft under the poor bar, and into a good coppery lode, is important. Fully 300 feet of continuous stoping ground has been opened at 19th level in the vicinity of this shaft. The pitch of this ground is south, gaining quite rapidly in that direction.

It would be more satisfactory if your attention could be directed to the expectation of a higher grade of rock in future. Though this is not impossible, yet in such a bunchy mine it would not be wise to do so. This, however, can safely be said,—the mine has never in its history looked more promising for a continuance than at this time, and if our expectations are met, going south of No. 4 shaft, more extensive operations must follow in due course.

Our work on the West Amygdaloid has not encouraged us to develop it on a more extensive scale. We got from it 1,150 tons of stamp rock, rich in copper, and 62½ tons of barrel work. As we leave seven-eighths of the rock we break underground, in the conglomerate workings, the copper obtained left us a margin of profit. Under the circumstances we shall continue the work, hoping to find a rich bunch that is extensive enough to be important.

As you are aware, it had been settled for some time that a cross-cut should be driven from one of our deep levels to the conglomerate. Developments in the neighboring mine on that lode indicate the possibility of copper ground being prolonged south into our property. To prove this, the cross-cut was started at 16th level. As we expect to drive not less than 80 feet monthly, the conglomerate will probably be reached next September. The lode will be seen 600 feet deeper than it has been proved on our property. The result may be regarded as purely speculative, but I think the expenditure a most judicious one. The importance to us of finding only a moderate good conglomerate can scarcely be estimated.

Rock house expenditures are much the same as in previous years. Of the rock hoisted, 161,929 tons, there were discarded 24,204 tons, and 137,725 tons were sent to mill.

Transportation and filling of rock cars cost us 15 55-100 cts per ton, railroad company keeping tracks clear of snow, and affording every facility for dispatch of work.

Stamping was done, after the whole mill was complete in January, with great regularity. Osceola rock amounted to 137,725 tons, Tamarack 71,889 tons, or a total of 209,615 tons stamped, cost of stamping being 34 52-100 cents per ton. Considering that 39 per cent. was conglomerate rock, there is every reason for being satisfied with the duty of the mill.

The heavy items of construction account were for completion of the stamp mill and surroundings, and for new school-house at the mine. Unless we make preparations for the rapid development of our south ground, which will be determined later, there will be no call for any important extra expenditures for the year.

Plans of the mine have been prepared by Mr. Klepetko, our engineer. Also a detailed summary of the year's accounts, by Mr. J. H. Vivian, clerk, to be submitted to you.

The staff of officers continue the same, and to them my thanks are due for continued regularity with which work progresses. Very respectfully,

JOHN DANIELI, *Superintendent.*

PERCENTAGE OF COST IN EACH DEPARTMENT IN 1886.

West vein.....	.04439
Amygdaloid .....	.70155
Rock-house.....	.07018
Transportation.....	.08169
Stamping.....	.05542
Incidental.....	.01990
Surface.....	.00565
Office.....	.02122
Whole number of men.....	364
Total expenditures.....	\$262,063 44
Fathoms of ground broken.....	9,228
Tons of rock hoisted.....	161,929
Tons of rock discarded.....	24,204
Tons of rock stamped.....	137,725
Pounds of mineral produced.....	3,808,490
" " masses.....	325,055
" " mineral ".....	4,133,545
" " ingot ".....	3,560,918
Cost per ton of rock hoisted.....	\$1.6184
Cost per ton of rock stamped.....	1.9028
Cost per ingot copper per lb.....	.0736
Percentage of stamp rock in rock hoisted.....	.85 5-100
" " mineral in rock hoisted.....	.01176 lbs to the ton, 23.52
" " " " stamped.....	.01383 " " " " 27.66
" " masses " " hoisted.....	.001 " " " " 2
" " " " " stamped.....	.00118 " " " " 2.36
" " " " total product.....	.0736 " " " " 157.20
" " mineral product in rock hoisted.....	.01276 " " " " 25.52
" " " " " stamped.....	.015007 " " " " 30.01
" " ingot copper " " hoisted.....	.01099 " " " " 21.98
" " " " " stamped.....	.01293 " " " " 25.86
" " " " mineral product.....	.8615
Pounds of ingot copper in each ton of mineral.....	1,723
Total cost of working air drills.....	\$23,814 02
Number of drills worked.....	21
Average number of men working drills.....	78.54
Transportation cost per ton of rock, including the loading of cars.....	15.55 cents.

STAMP MILL ITEMS.

Total number of days run.....	288.13
Tons of Osceola rock stamped	137,725
Tons of Tamarack rock stamped	71,889
Total rock stamped	209,614
Tons of rock stamped per ton of coal or unit of fuel.....	22.47
Average per cent of mineral in rock.....	.01383
Cost of stamping per ton, including Tamarack .....	.3452

STAMPING EXPENSE 1886.

1886.	Amount.	1886.	Amount.
Superintendent.....	\$16 80	Cost of fuel.....	\$31,535 00
Engineers.....	1,351 50	Illuminating oil.....	130 60
Firemen.....	2,948 70	Lubricating oil.....	1,035 37
Coopers and carpenters	1,543 56	Stamp shoes.....	2,615 27
Watchmen	539 70	Hardware.....	528 97
Machinists	1,701 58	Iron and steel.....	2,696 49
Smiths.....	868 39	Tools and machinery	
Head runners.....	1,154 35	Waste.....	125 73
Head feeders.....	3,717 25	Packing and belting	235 08
Oilers	1,029 35	All other supplies.....	2,851 38
Sundry labor.....	4,701 03	Total supplies.....	41,753 89
Tramming	465 65	Amount of labor brought down	30,568 73
Overseers of work-house.....	860 00	Incidental.....	36 90
Copper washers.....	1,194 55	Stamping Tamarack rock	57,836 12
Laborers and machinists.....	6,433 70	Total expense, not including Tamarack stamping, i. e., cost of stamping Osceola rock	14,523 40
Silver pickers.....	225 40		
Assaying	61 02		
Total.....	30,568 73		

Wood supplies, per cent.....	57.76
Labor lost, per cent.....	52.24

Table of product of Osceola mine :

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1874.....	468		1881.....	2,089	1,876
1875.....	665	303	1882.....	2,088	782
1876.....	846	1,737	1883.....	782	2,128
1877.....	1,382	777	1884.....	2,123	1,630
1878.....	1,352	1,998	1885.....	969	1,169
1879.....	1,589	1,387	1886.....	1,780	786
1880.....	1,691	1,387			
Total.....				19,186	491

ANNUAL REPORT OF THE
THE PENINSULAR MINING CO.

did a small amount of work of an exploratory kind in the last year but finally closed down again.

There is no likelihood of the resumption of mining work in the near future. There is nothing to describe beyond what is given in previous reports.

S. D. North, Prest., Hancock, Mich.

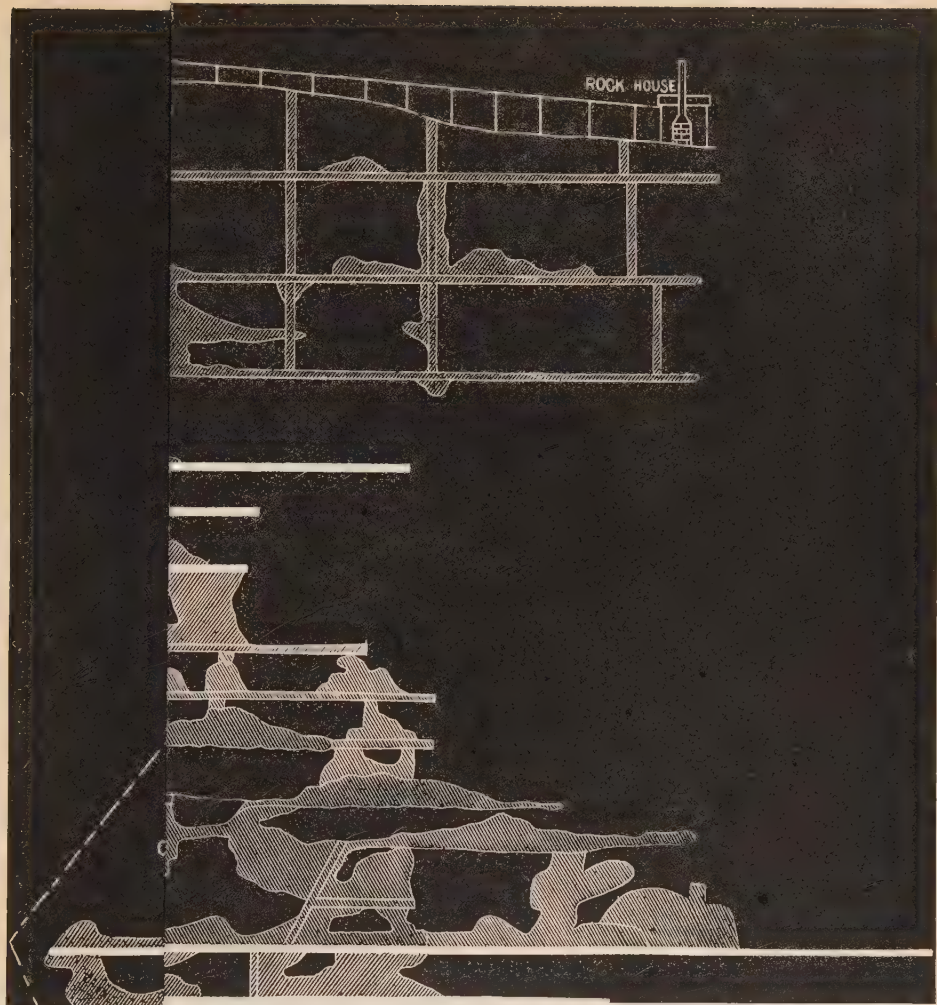
THE QUINCY MINING CO.

The Quincy is the richest amygdaloid mine in the State. In the per cent. of yield of mineral of the rock, in the aggregate of production, in the annual profits of its work, it ranks only second to the Calumet and Hecla.

This position it has held for years and there is no diminution in the richness of the mine. It was never better than it is now, though of course it is each year getting deeper. The Quincy has a large territory, so that it can never be circumscribed for the want of ground to extend its opening into, but it is possible that the deposit may become leaner. They may not always have the rich ground that has held for so many years in the mine.

In this respect the Calumet and Hecla enjoys an advantage. That mine is proved far ahead of present working. The Quincy is not; a few years of stoping in poor ground would lessen the product and cripple its resources. There is no reason to apprehend any such occurrence, only the experience in all amygdaloid belts—and in conglomerate, too, as to that matter—shows that good ground is likely to be succeeded by poor.

The Pewabic was once as rich as the Quincy and continued to be so for years, or until the deposit in the old mine was all exhausted; but when the advance was made into the new ground—the Edwards and Uren purchase—the mine became poor and did not pay to work. It is possible that a similar experience may await the Quincy, and to avoid possible, serious future embarrassment, it would seem to be the part of wisdom to prove the ground far in advance of the present stoping. It must be remarked that the map scarcely indicates the full extent of the stoping ground opened, without an accompanying ground plan. The mine is in two deposits, so designated, east and west deposits, which open into each other by cross-drifts, either through rock or in amygdaloid connections, so that it is a wide mine and a very irregular one. It must be borne in mind also that much of the ground standing in the mine—and it will be seen from the map that there is very much of it—is good paying amygdaloid that will be mined and crushed as occasion requires. This is the mine's reserve, and there is enough of it to tide over a long period of occurrence of poor ground in the bottom. The Quincy is a conservative, well managed corporation and well



sustains its share of the credit of our mining interests and makes its pecuniary returns to its stockholders of such magnitude and with such regularity, that its shares are ever esteemed as among the safest and most profitable investment.

For the second time in recent years the Quincy has met with the loss of its rock house by fire. Early in June, 1887, the rock house was struck by lightning, occasioning its total loss. Steps were immediately taken for its rebuilding, and the delay will be of short duration.

The following statements by the company cover all the further information that is essential:

QUINCY MINE REPORT.

The directors submit the following report of the business of the mine for the past year, and statement of the financial condition of the company.

The shipment of the season was 6,974,300 pounds of mineral, which has been smelted and yielded about 82 48-100 per cent, or 5,752,816 pounds of refined copper.

The product of the mine, as prepared for shipment, was 7,153,500 pounds, or 3,576 1800-2000 tons of mineral, of the following description, namely:

Stamp copper.....	6,748,785 lbs
Mass ".....	404,715 "
	7,153,500

For which, estimating copper on hand, unsold, at 11 cents per pound, has been realized

The gross sum of.....	\$640,292 17
Realized from sale of silver.....	3,349 39
	\$643,641 56

The expenses of the year are as follows:

Running expenses at mine.....	\$311,369 30
Building and construction account.....	27,614 75
Smelting, transportation and all other expenses.....	99,425 43
	\$438,409 48

Which, deducted from gross earnings..... 643,641 56

Leaves as mining profit..... \$205,232 08

There has also been realized during the year, from interest on loans..... 9,488 97

From real estate, "Hancock,"..... 1,060 00

\$215,781 05

The statement of assets and liabilities in our last report showed a balance on hand, as of date,

January 1, 1886..... \$573,000 41

Add earnings of 1886..... 215,781 05

\$788,781 46

Deduct dividend of February 15, 1886..... \$160,000

" " " August 16, 1886..... 80,000 \$240,000 00

Leaving balance of assets, January 1, 1887..... \$548,781 46

A dividend of \$4.00 per share, or \$160,000, payable February 15, has been declared which, with dividend of \$2.00 per share, paid August 16 last, makes a total for the year \$240,000.

The usual financial statements are submitted, and also the report of the agent, which states clearly the present condition of our property.

THOMAS F. MASON, *President,*

New York, February 12, 1887.

GENERAL SUMMARY OF RECEIPTS AND EXPENDITURES OF THE QUINCY MINING COMPANY, FROM ITS ORGANIZATION TO DECEMBER 31, 1886.

Expenditures.

For expenditure on location previous to 1886.....	\$42,097 98
" " " Quincy vein, 1858, not now worked.....	55,000 00
For openings and explorations on 3,800 feet "east" or Pewabic vein, extending to Portage Lake, preparatory to future work.....	11,500 00
For real estate and permanent improvements on same, including dwelling houses, stamp mill, machinery, steam engines, tram road, dock, warehouses and other buildings and roads.....	942,560 94
For mining and surface labor, expenses of smelting and marketing copper, and all incidental expenses.....	11,966,007 60
Balance carried down.....	4,958,781 46
	<u>\$17,975,947 98</u>

Receipts.

From capital stock paid in.....	\$200,000 00
From proceeds, copper and silver (88,243,927 lbs. copper).....	17,522,181 35
From interest.....	116,229 04
From profit on sale P. L. & R. Improvement Company stock, and other investments...	79,637 16
From sales of real estate, Hancock, Michigan.....	57,950 43
	<u>\$17,975,947 98</u>
By balance brought down, being receipts over expenditures.....	\$4,958,781 46
Deducting dividends declared, Nos. 1 to 36 inclusive.....	4,410,000 00
Leaving balance as per statement in detail on next page.....	<u>\$548,781 46</u>

STATEMENT OF ASSETS AND LIABILITIES, EXCLUSIVE OF REAL ESTATE, MINE PLANT AND SUPPLIES IN USE, JANUARY 1, 1887.

Assets.

Loans on call.....	\$300,000 00
Cash in bank.....	20,641 24
Cash on hand at mine.....	8,489 86
Copper on hand.....	202,196 57
Accounts receivable—since paid.....	15,066 00
	<u>\$546,393 67</u>

Liabilities.

Drafts unpaid.....	\$1,311 80
Dividends unpaid.....	738 00
Accounts payable in New York.....	16,700 00
" " at mine.....	33,767 51
	<u>52,566 81</u>
Add at mine, viz:	<u>\$493,826 86</u>
Supplies per inventory on file.....	\$47,055 69
Farm accounts (horses, wagons, etc.).....	7,756 81
Accounts receivable.....	142 10
	<u>54,954 60</u>
Less dividend payable February 15, 1887, \$4 per share, \$160,000.	<u>\$548,781 46</u>

Summary for Year.

Average force employed.....	415 men
" number of miners.....	140 "
" wages of miners on contract, per month.....	\$45 80
Yield of mineral per fathom of ground broken.....	777 lbs
" refined copper per fathom of ground broken.....	638 "
Total rock mined.....	165,618 tons
" hoisted.....	115,608 "
" stamp rock treated.....	109,702 "
Yield of rock stamped 3.06 per cent.....	6,748,785 lbs
Product mineral.....	7,153,500 "
" refined copper.....	5,923,519 "

AGENT'S REPORT.

Quincy Mine, Lake Superior, Mich., January 31st, 1887.

The results of our operations at the mine for the past year have fully realized our anticipations, and I herewith submit the following report.

In the northern part of the mine the openings made by drifting on the vein, by cross cutting and by winzes, were at the twenty-second, twenty-fourth, thirty-first, thirty-second, thirty-third and thirty-fourth and thirty-fifth levels north and south of No. 2 shaft.

The openings made in the southern part of the mine by drifting, etc., were at the twenty-second, thirty-second and thirty-third levels, south, and the thirty-fourth and thirty-fifth levels north and south of No. 4 shaft. All those levels are now connected with both shafts.

No. 4 shaft was sunk from the thirty-fourth level to a point fifty feet below the thirty-fifth level; but No. 2 shaft was not sunk below the thirty-fifth level during the year.

The stoping done was at various places between the twenty-second and the thirty-fifth levels north and south of No. 2 shaft, and between the twenty-second and the thirty-fourth levels north and south of No. 4 shaft.

The most productive ground worked was at the thirty-second, thirty-third and thirty-fourth levels north and south of No. 4 shaft and at the thirty-second, thirty-third, thirty-fourth and thirty-fifth levels north and south of No. 2 shaft.

The diamond drill work was limited during the year. The total number of holes bored was only some eighteen or twenty, and the aggregate depth of drilling about 2,000 feet.

Those explorations were at different points in the twenty-second, twenty-fourth, thirtieth and thirty-fifth levels, and for the most part developed nothing of an unusual character.

The man-engine shaft in course of extension below the twenty-seventh level, at the end of last year, was completed to the twenty-ninth level, and a further extension will probably be made during the present year.

Of the principal improvements by way of construction account, under consideration at the last annual report, the following have been carried out, viz: At No. 2 shaft some additional changes and improvements were made to the hoisting plant.

At No. 4 shaft the new drum was put in operation in July. Previous to this the shaft had been straightened and retimbered for two levels below the surface, and the dump in the shaft house lowered and changed.

The mine pump bob pits and bobs at the surface were entirely rebuilt and enclosed with small, substantial frame buildings.

Several of the tenement houses received necessary repairs, and two other dwelling houses were purchased from parties who had built them at their own expense on the company's land.

At the man-engine shaft a set of iron "angle" or balance bobs was placed at the fourteenth level, and a set of iron "V" bobs was placed at the thirteenth level. This improvement was rather an expensive undertaking, but nothing better could be devised, and the bobs admirably answer the purposes for which they were designed.

During the summer the Mineral Range railroad company constructed a branch line to connect with our mine boiler-house, which makes it more convenient for the transportation of coal, wood, or other freight from the dock to the mine.

A coal yard was made at the mine boiler-house, and the coal bin at the dock was removed to a more favorable position for receiving and discharging coal.

The mine office building, and the mine supply building, which had become extremely dilapidated, were thoroughly overhauled and repaired, making them practically as good as new.

A new fire plant for the mine, consisting of a size "E" Worthington pump, with some twenty-three hundred feet of four-inch pipe, and suitable hydrants, was purchased, and partially laid; but owing to some unaccountable delay in shipping them, the pipes were not received in time to complete the work before winter set in.

At the stamp mill a small addition was made to what is called the "Little Mill Building," for the purpose of furnishing storage for iron, and for such pieces of machinery under repairs as heretofore have been crowded into the mill machine shop.

The dock extension, spoken of in the last annual report, was also made. The expense of this, together with the improvements already mentioned, make the construction account for the present year a total of \$27,614 $\frac{75}{100}$.

During the present year it will be necessary to rebuild the "tram road," or "incline," as it is called, from the "drum house," to the stamp mill, and to procure a new dump scow of larger size than the old one now in use, for the removal of waste stamp sand.

The mine maps enclosed, which are filled up as usual to the end of the year, will show the diamond drill borings, and, as near as may be, the extent of openings made, and the ground in reserve available for stopping.

The general appearance of the mine is altogether encouraging.

There is a decided improvement of the vein in the lower levels, particularly so in the vicinity and south of No. 4 shaft, while at No. 2 shaft, and north of it, the vein holds its own remarkably well.

For the successful accomplishment of the year's work I am under renewed obligations to the several officers of the mine, all of whom have been in hearty coöperation, and have labored faithfully and well.

S. B. HARRIS, *Agent*.

Table showing yearly product of Quincy mine:

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1856.....	6	1,462	1872.....	1,134	1,134
1857.....	61	762	1873.....	1,400	.....
1858.....	153	772	1874.....	1,525	654
1859.....	178	1,114	1875.....	1,334	281
1860.....	970	414	1876.....	1,536	1,171
1861.....	1,218	852	1877.....	1,427	336
1862.....	1,153	218	1878.....	1,480	449
1863.....	1,115	1,737	1879.....	1,323	1,458
1864.....	1,251	586	1880.....	1,848	263
1865.....	923	1,500	1881.....	2,753	884
1866.....	1,172	1,000	1882.....	2,832	1,796
1867.....	1,013	1,000	1883.....	3,006	239
1868.....	727	1,000	1884.....	2,825	436
1869.....	1,208	1,365	1885.....	2,924	497
1870.....	1,248	1,777	1886.....	2,961	1,529
1871.....	1,204	1,501			
Total.....				44,059	151

THE PEWABIC MINE

is still idle and matters regarding it remain as stated in last report.

THE FRANKLIN MINE

affords continued evidence of the effects of good management. The mine is in a prosperous condition, a dividend-paying mine, notwithstanding the low price of copper; whereas, years ago, before Capt. Vivian took charge of the mine, it did not pay expenses. And this, too, with copper at double its present price, and with the same machinery and outfit as are still used at the mine. A few years ago, after the mine had been worked on tribute until the stopes were all exhausted, and the machinery, railroad, buildings, stamp mill, etc., were all out of repair, the company resumed work, with an empty treasury; and without calling upon the stockholders for a penny of assessment, the mine has been brought to a prosperous, independent position. All the requisite funds have been ultimately derived from the sales of the copper produced.

Of course, money had to be used before copper could be mined and sold. To obtain these necessary early advances, Messrs. Demmon and Vivian pledged their personal credit to an extent that their private estates were completely identified with the success of the mine.

They demonstrated the value of the Franklin mine, and their eminent ability to manage it successfully.

There is not much to be said that is new. The shaft houses have all been built over new. This was accomplished without delaying the hoisting. In going over the location one sees many small changes that are excellent, alteration of boilers, of machinery, etc., that are both economical and effective. One sees the evidence of a management that looks after every detail, and makes machinery, etc., do effective duty that some managers would think it necessary to discard as obsolete, worn out, and worthless.

The following is the complete financial statement, etc., of the company:

MINING EXPENSES.

Number of men.....	126
Mining captains, timbermen.....	\$12,331 29
Miners on day account.....	1,523 97
Machinists, engineers, firemen.....	12,019 10
Blacksmiths, carpenters.....	3,328 32
Trammers, laborers.....	32,272 96
Total.....	\$61,473 73

STATEMENT OF SHAFTS AND WINZES SUNK AND COST OF THE SAME.

Number of men.....	9
Number of feet of shaft sunk.....	489
Average price per foot for sinking shafts.....	\$14 84
Total amount paid for sinking shafts.....	\$7,390 48

STATEMENT OF DRIFTING AND CROSS-CUTS MADE AND COST OF SAME.

Number of men.....	30
Number of feet drifted.....	2576 3-10
Average price paid per foot for drifting.....	\$9 81
Total amount paid for drifting.....	\$25,188 04

MINING EXPENSES.

Special contracts.....	\$52 50
Extras.....	1,240 14
Main engine, wood supply and royalty.....	4,644 10
Diamond drill.....	842 08
Survey in mine.....	199 00
Total.....	\$8,977 82

STATEMENT OF STOPING AND COST OF SAME.

Number of men.....	112
Number of fathoms stoped by air drills.....	9174 302-1000
“ “ “ “ “ hand drills.....	0
Average price paid for stoping with air drills.....	\$9 97
Total amount paid for stoping.....	\$91,541 94

STATEMENT OF SUPPLIES, FUEL, ETC., AND COST OF SAME.

Supplies.....	\$12,139 36
Wood, coal and iron.....	30,722 69
Total.....	\$42,862 05
Less profit on miners' supplies.....	18,504 40
Total.....	\$24,357 65

RECAPITULATION OF MINING EXPENSES.

Company account labor.....	\$61,473 73
Sinking shafts and winzes.....	7,390 48
Drifting and cross-cutting.....	25,188 04
Stoping.....	91,541 94
Sundry labor.....	6,977 82
Supplies, fuel.....	24,357 65
Total.....	\$216,929 66
Number of men on company account.....	126
“ “ “ “ contract.....	150½
Total.....	276½
Number of tons of rock hoisted to surface.....	175,130
“ “ “ “ “ rejected.....	36,745
“ “ “ “ “ sent to mill.....	138,385
Per cent of rock rejected.....	20.98
Total number of feet drifted.....	2576.30
“ “ “ fathoms stoped.....	9174.302
“ “ “ feet sunk.....	498

SURFACE EXPENSES.

Number of men.....	34
Total amount of wages paid.....	\$16,198 64
Teaming and supplies.....	5,540 95
Wagons, sleighs, harness, repairs, etc.....	443 95
Total.....	\$22,093 54
Less house rent and other charges.....	7,929 22
Net total.....	\$14,154 26

STAMP MILL EXPENSES.

Number of men.....	56
Number of cords of wood.....	11,777.50
Cost of wood.....	\$33,398 83
Foundry expenses.....	3,767 03
Cost of other supplies.....	4,701 84
Cost of labor.....	21,728 39
Total.....	\$83,595 59

STATEMENT SHOWING RESULTS OF STAMPING.

Number of days run.....	240
Number of tons stamped.....	138,385
Per cent per ton.....	1.29
Number of pounds of copper produced.....	3,572,064
Number of tons of rock stamped per cord of wood used.....	11.75
Cost of stamping one ton of rock.....	\$0.4595

No. 2 shaft sunk 210 feet below the 27th level	
" 3 " " 110 " " " 26th "	
" 5 " " 178 " " " 24th "	

TRAM ROAD EXPENSES.

Number of men.....	15
Cost of labor.....	\$6,774 99
Cost of supplies.....	1,582 95
Total cost.....	\$8,357 94
Number of tons of rock run over the road.....	138,385
Cost per ton to transport.....	\$0.603
Insurance, etc.....	9,307 28

ROCK HOUSE EXPENSES.

Number of men employed.....	36
Cost of labor.....	\$14,810 28
Cost of supplies.....	865 14
Total cost.....	\$15,175 42
Number of tons of rock passed through breakers, etc.....	138,385
Cost per ton for breaking and delivering.....	\$0.10.96
Cost of hauling one ton of rock hoisted.....	0.0866
Office expense, clerks, etc.....	2,505 97

CONSTRUCTION AND REPAIRS, ETC.

Repairing houses.....	\$620 71
New dock and bulk head.....	2,088 66
Building fence.....	29 60
Addition to house—mining captain.....	179 46
Moving warehouse.....	217 63

SUMMARY OF EXPENDITURES.

Number of men.....	422
Mining expenses.....	\$216,929 66
Surface expenses.....	14,154 26
Stamp mill expenses.....	63,595 59
Tram road expenses.....	8,357 94
Rock house expenses.....	15,175 42
General expenses.....	9,807 29
Office expenses.....	2,505 97
Construction account and repairs.....	3,136 06
Total.....	\$333,162 19
Total number of pounds of mineral produced.....	5,224,794

Per cent ingot to mineral	81.61
Total number of pounds of refined copper produced	4,264,297
Cost of the mineral per pound at smelting works	\$0.0637
" " " ingot " " " "	0.0781
Number of fathoms of rock hoisted	9729
" " tons " " "	175,120
Cost of rock per ton	\$1 90
Number of pounds of mineral in each fathom of ground	537
" " " " ingot " " " "	438
" " " " mineral " " ton of rock hoisted	29.83
" " " " ingot " " " " "	24.34
Per cent of mineral in ton of rock hoisted	1.49
" " " ingot " " " " "	1.21
Pounds of mineral in each ton of rock stamped	37.75
" " ingot " " " " "	30.81
Per cent of mineral in tons of rock stamped	1.88
" " " ingot " " " " "	1.54
Total running expenses for the year	\$333,162 19
Tons of rock on hand January 1st, 1886	25,008
" " " mined during year	177,640
" " " hoisted " "	175,130
" " " on hand January 1st, 1887	27,518

MEMORANDA.

Pounds of mineral in fathoms of rock hoisted	537
" " ingot " " " "	438
" " mineral " ton " "	29.83
" " ingot " " " "	24.34
" " mineral " " " " stamped	37.75
" " ingot " " " "	30.81
Per cent of mineral in rock stamped	1.88
" " " ingot " " "	1.54
" " " mineral " " hoisted	1.41
" " " ingot " "	1.21
Cost of mineral at smelting works	\$0.0637
" " ingot " " " .....	.0781

INVENTORY.

Machinery at Mine.

- 1 hoisting engine and 9 boilers.
- 1 pumping engine and 1 boiler.
- 1 pumping engine in machine house.
- 1 pumping engine in carpenter shop.
- 3 underground pumping engines.
- 3 underground hoisting engines.
- 1 saw mill.
- 1 fire pump in compressor house.
- 1 fire pump in hoisting engine house.
- 1 fire pump in locomotive engine house.
- 2 Burleigh compressors.
- 1 Double Allison compressor.
- 1 air receiver.
- 1 boiler in compressor house.
- 2 heaters in compressor house.
- 34 Rand air drills.
- 3 rock breakers.
- 1 spare engine 14" x 24" in ware-house.
- 9,000 feet water works pipe from mill to mine.
- 1 small engine and boiler.

Stamp Mill Machinery.

1 Corliss engine and 4 boilers.
 1 pumping engine.
 1 pumping engine.
 1 pumping engine, old one.
 4 heads Ball stamps.
 48 Collum washers, shafting, belting, etc.
 4 sheive tables.
 2 percussion tables.
 2 20" lifting pumps.
 1 Worthington pump.
 1 engine for hoisting coal.
 1 10x44x10 Worthington pump for the water works.

Tram Road.

2 locomotives. 50 rock cars. Road from mine to mill, gauge 3' 3", laid with T rail; renewed in 1884.

The following is the company's published statement of the year's business:

FRANKLIN MINE REPORT.

To the Stockholders of the Franklin Mining Company:

Annexed we hand you the usual annual statement of the affairs and doings of your company for the year 1886, with our agent's reports of the workings for that year, of the condition of the mine January 1, 1887, and its probable prospects for the future, which certainly seem as fair as a year ago.

The entire plant is in better condition, there is more rock broken in the mine and ready for hoisting, the openings are fully as large as they were January 1, 1886, the machinery in all its details is in first-class order, and all seems to promise as well for 1887 as could reasonably be expected. The price of copper, seemingly, being the only question for at least as successful a year as 1886. The present position, however, if we may judge by statistics, is in favor of an advance in price of the article.

Captain Johnson Vivian still has charge of our property at the Lake, and the result of the year's doings gives the facts as to his fitness for the situation.

There is in the mine, broken and ready for hoisting, 27,518 tons of rock, which is not valued as an asset.

During the year, 138,385 tons of rock were treated at the mill, a gain over 1885 of 1,109 tons, producing 5,228,400 lbs. of mineral, which gave a yield of 81 623-1000 per cent. of refined copper, or 4,264,297 lbs., being a gain over 1885 of 265,125 lbs. of refined copper.

The amount of mineral per ton of rock stamped was 1 88-100, or 13-100 per cent. more than 1885.

The percentage of copper in a ton of rock hoisted was 1 21-100, which is an increase of 8-100 over 1885.

The total cost of mining and manipulating per ton of rock hoisted was \$1.90, or five cents per ton less than 1885.

Total amount of rock hoisted was 175,130 tons, a gain over 1885 of 1.514 tons.

Respectfully submitted, for the directors,

D. L. DEMMON, *Treasurer.*

AGENT'S REPORT.

*Hancock, Mich., Jan. 20, 1887.*D. L. DEMMON, ESQ., *Treasurer.*

Dear Sir :—I beg leave to submit the following report of the work performed for the year ending December 31, 1886, with map of the mine showing the extent of the openings, stopes, etc., together with inventory of supplies, tools and machinery. Also tabular statements which have been very carefully and neatly compiled by the clerk, Mr. Arno Jaehnig, giving in detail the cost of each department of our business, etc.

SURFACE.

In this department we have for many years paid considerable attention to repairs and improvements which have put it into such good condition that little remained to be done in the year just closed. The improvement of importance was a dock built at the Lake for landing general merchandise on, and one for receiving coal. Both have been constructed in a very substantial manner, and will last for a great many years.

MACHINERY.

We have not added anything of importance to the machinery during the past year. All repairs necessary have had prompt attention, and nothing of a serious nature has happened to anything connected with it causing any hindrance over a few hours, and all at this time is in good condition and running smoothly and regularly.

STAMP MILL.

We have treated 138,385 tons of rock, which is in excess of 1885 1,109 tons. For a mill that is so old as this, it is in very fair condition, and will not require any very heavy repairs for the ensuing year. We shall put in six new washing machines at an early day to take the place of the same number that are too badly decayed for further use, the extra cost of which will not exceed two hundred and fifty dollars.

MINING WORK.

The following openings have been made :

Shafts sunk.....	498 feet.
Drifting.....	2,576 feet.

The total amount of ground broken was 9,868 918-1000 fathoms, or 177,640 tons of rock, of which 175,130 tons were hoisted to the surface. The amount of rock rejected was 36,745 tons, at 20 98-100 per cent. of the amount taken out of the mine. The quantity of rock on hand

January 1, 1886 was.....	25,008 tons.
Broken during the year.....	177,640 tons.
<hr/>	
Hoisted as above stated.....	202,648 tons.
	175,130 tons.
<hr/>	
Leaving on hand Jan. 1, 1887.....	27,518 tons.

The cost of manipulating a ton of rock, and delivering the mineral to smelting works,

was 1 30-100, which is a saving of five cents per ton over 1885, or a total for the year of \$8,680 80-100. The percentage of copper in a ton of rock hoisted was 1 21-100, which is an increase of 6-100 over 1885.

The shafts have been sunk as follows: No. 2 from the twenty-eighth to the twenty-ninth level; No. 3 from the twenty-sixth to the twenty-seventh level; and No. 5, from a point 30 feet above the twenty-fifth, to the twenty-sixth level. Openings, by drifts, have been regularly made from the above mentioned shafts, from the twenty-third to the twenty-eighth level. The appearance of the lode exposed in these openings seems to be, on the whole, a fair average of what we have had for the last two or three years. The depths of our shafts are as follows: No. 2, 2,350 feet; No. 3, 2,125 feet; No. 5, 2,000 feet.

PROSPECTS FOR 1887.

After a careful survey of the ground now available for stoping, and what we can reasonably expect to open, we are satisfied that, at least, 2,400 tons of mineral can be produced for 1887. As there is nothing in the shape of new machinery or other improvements required, the expenses for the ensuing year will not be materially increased over the past, if any.

I again take pleasure in saying that my assistants, Capt. Thomas Dennis, Mr. Arno Jaehnig, the clerk, and Mr. James Moore, the engineer, continue to promote the best interest of the company.

I am, yours respectfully,

J. VIVIAN, *Supt.*

FRANKLIN MINING COMPANY, CASH ACCOUNT, FOR THE YEAR ENDING DECEMBER 31, 1886.

Cash on hand January 1, 1886.....	\$149,782 97
Cash received from sales of copper, 3,651,160 lbs., at 10 373-1,000c.....	396,975 13
Cash received from sale silver.....	1,113 47
Cash received from interest.....	850 39
	<hr/>
	\$548,721 96
<i>Contra.</i>	
Cash paid dividend, January 1, 1886.....	\$40,000 00
Cash paid dividend July 1, 1886.....	40,000 00
Cash paid Mine Agent's drafts.....	348,609 15
Cash paid insurance.....	923 00
Cash paid storage.....	107 34
Cash paid smelting.....	41,708 29
Cash paid freight.....	16,384 93
Cash paid expense, brokerage, taxes, legal expenses, etc.....	8,658 55
Cash paid loans.....	30,000 00
Cash on hand December 31, 1886.....	22,330 70
	<hr/>
	\$548,721 96

FRANKLIN MINING COMPANY, PROFIT AND LOSS ACCOUNT, FOR THE YEAR 1886.

	<i>Receipts.</i>	
2,943,794 lbs. copper sold at 10 707-1,000c.....	\$315,185 10	
1,321,625 lbs. of copper on hand at 10½c.....	138,766 62	
Silver sold.....	2,001 20	
Received for interest.....	850 39	
	<hr/>	
	\$456,807 31	
	<i>Expenditures.</i>	
At mine, as per yearly cost sheet.....	\$333,162 19	
All other expenses, including smelting, freight, insurance, etc., etc.....	65,190 65	
Profit and loss. Profit for 1886.....	58,454 47	
	<hr/>	
	\$456,807 31	
Highest price in 1886, 12 cents.		
Lowest price in 1886, 9 75-100 cents.		

FRANKLIN MINING COMPANY, ASSETS AND LIABILITIES DECEMBER 31, 1886.

Assets.

Cash on hand.....	\$22,330 70
Copper on hand, 1,321,625 lbs. at 10½c.....	138,770 62
1886, silver (sold).....	2,001 20
Supplies at mine.....	76,174 95
Notes receivable.....	30,000 00
	<hr/> \$269,277 47

Liabilities.

Drafts accepted and in transit.....	\$15,289 11
Liabilities at mine.....	28,403 32
Due for smelting and freight.....	9,901 83
	<hr/> 53,591 26
Surplus December 31, 1886.....	\$215,683 21

From which a dividend of one dollar per share, or \$40,000, was paid January 1, 1887.

D. L. DEMMON, Treasurer.

Yield in 1881, 2,667,952 lbs. refined copper.
Yield in 1882, 3,234,120 lbs. refined copper.
Yield in 1883, 3,489,308 lbs. refined copper.
Yield in 1884, 3,748,652 lbs. refined copper.
Yield in 1885, 3,999,172 lbs. refined copper.
Yield in 1886, 4,264,207 lbs refined copper.

The Franklin mine has produced as follows:

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1857.....	3	699	1872.....	186	-----
1858.....	56	1,104	1873.....	183	-----
1859.....	116	1,211	1874.....	283	1,790
1860.....	157	1,860	1875.....	583	800
1861.....	783	43	1876.....	963	641
1862.....	733	645	1877.....	1,169	1,817
1863.....	639	684	1878.....	1,299	1,528
1864.....	605	1,335	1879.....	1,414	1,703
1865.....	779	1,481	1880.....	1,168	466
1866.....	819	994	1881.....	1,338	1,932
1867.....	701	455	1882.....	1,632	120
1868.....	737	1,326	1883.....	1,744	1,308
1869.....	779	970	1884.....	1,882	1,697
1870.....	589	-----	1885.....	1,999	1,172
1871.....	300	1,000	1886.....	2,132	297
Total.....				25,782	478

D. L. Demmon, Sec. and Treas., Boston, Mass.



HURON COPPER COMPANY.

It is surprising how well the Huron mine sustains itself, considering the price of copper and the somewhat restricted scale on which it is worked. A few years ago and the Huron was an abandoned mine, while now, without much additional outlay, it is, considering the circumstances, a large producer of copper, and is producing it, too, at a margin of profit. This much has been demonstrated regarding the Huron: if it were provided with machinery and stamp mill facilities equal to those found at the other important mines in the district, it would undoubtedly produce as much copper, and produce it as cheaply as the others. That is, it would be an entirely self-supporting and dividend-paying mine. Open it as extensively, and work it as largely as other mines are penetrated and worked, and it is reasonable to conclude, from the facts already determined, that it would be as successful. The so-called Isle Royal lode, in which the Huron belongs, is like most other amygdaloid belts, irregular and pockety, rich and poor in places. It must be extensively opened and worked to give any profit. In this way enough good ground will be developed to afford all necessary stopes, and the poor may be left standing. It is well understood now, that copper mining in Michigan cannot be conducted successfully on a small scale. The only way that the depression in price has been met by the companies that continued to operate, is by pushing the work more vigorously, opening the mine more largely, and increasing the output. They lessen the cost by increasing the magnitude of the operations.

The Huron, if it is to continue to work, needs a considerable outlay of money to provide all the facilities for working the mine as the other mines in the vicinity of Portage Lake are worked. There is no mine under better management, none where more has been accomplished under such adverse conditions. Capt. Vivian has put a world of energy in the work of rehabilitating this old mine. He knows perfectly well what is necessary to render it a success, and knows that what he is able to do is far from adequate to accomplish such a result. Still, he does not relax any effort. In fact, it requires the greatest watchfulness, the best management—and no management could be better than his—to hold to the position already achieved. He illustrates that Johnny Bull perseverance and tenacity of purpose that in so many ways have done so much for the world's advancement.

There are a number of mining men in the copper district, and Capt. Vivian is of the list, who are very valuable men. They combine thorough practical mining experience and energy of character with the best of executive ability. They are equal to any department of the work.

Some accidents, serious ones, to the stamp mill have occurred lately, to add to the perplexity. The first was the explosion of one of the boilers, and lastly,

the total destruction of the mill by fire. It was generally supposed that this latter catastrophe would cause the total suspension of work of the mine, but, on the contrary, the mill was speedily rebuilt, and is again in operation.

HURON MINE REPORT.

Boston, Mass., March, 1887.

To the Stockholders of the Huron Copper Mining Company :

Herewith we hand you the usual statements of the doings of your company for the year 1886, including our agent's report of the condition of the mine and its prospects for the future.

The ruling or average price of copper for the year (10 989-1000 cents per lb.) was a much lower price than we had reason to expect, and that, together with our limited amount of openings to produce rock from, are the principal causes for an unsuccessful year.

The property of the company, or rather the vein we are working, is one of the master lodes of the copper country, and for permanency and uniformity of show of copper, no other vein has exhibited stronger characteristics for so great a distance, and at all points opened, extending as it does from quite a distance on the north shore of Portage Lake to Evergreen Bluff, and beyond in Ontonagon county, some thirty or forty miles, and somewhere in this lode a very large development is to be expected. At the Huron, the vein has improved as depth was attained, the bunches of good ground have been larger, more frequent and richer, and no one familiar with the characteristics of the lode can doubt that more extensive openings and larger mill and hoisting facilities would soon put the mine in a strong position as a permanent and paying institution. Our length on this vein being amply sufficient, if fully opened, to supply eight to ten heads of stamps, or four or five times our present capacity, and it is believed by those fully posted in the matter, that your mine worked on as large a scale as its nearest neighbor, the Atlantic, would surely pay as well as that mine, even with copper at ten cents per pound.

In brief, the mine has an abundance of good copper ground, and will pay a good profit to work, if proper development and equipments are provided, and a reasonable price can be had for our product.

The situation of copper seems to be such that the price can hardly go lower, but that it should advance somewhat in price.

Captain Johnson Vivian still has charge of the mine, and has done all possible things to promote the best interests of the company.

For the directors,

D. L. DEMMON, *Treasurer.*

Below we give a detailed statement of expenditures at Lake and Boston for the past year :

Mining expenditures, labor, etc.....	\$42,024 82
Sinking 312 1-10 feet shafts, and 216 1-10 feet winzes.....	9,181 11
Drifting and cross-cutting 1,381 5-10 feet at \$11.53.....	15,283 43
Stoping 5,427 fathoms.....	55,433 12
Sundry labor, etc.....	249 00
Supplies and fuel.....	16,798 76

Surface expense.....	8,439 25
Stamp mill expense, 90,130 tons at 52 70-100c.....	47,503 16
Tram road expense, 90,130 tons at 2 90-100c.....	2,616 38
Rock house expense, 90,130 tons at 10 43-100c.....	13,465 58
General expense at mine and office.....	8,591 50
Or a total of.....	\$219,586 11
To which is to be added smelting, freight, insurance, expense, etc., paid in Boston.....	51,256 20
Or a grand total of.....	\$270,842 31

The total production of mineral for the year was 2,512,675 lbs., which gave a yield of 79 707-1000 per cent. refined copper, or 1,992,695 lbs. The highest price obtained during the year was 12 cents. Lowest, 9 $\frac{1}{4}$ cents. The average price was 10 989-1000 cents per lb.

HURON COPPER MINING COMPANY, CASH ACCOUNT FOR THE YEAR ENDING DECEMBER 31, 1886.

Cash on hand January 1, 1886.....	\$689 16
Cash received from sales of copper, 5,059,206 lbs. at 10 989-1,000c.....	226,281 85
Cash received from sale silver.....	200 0
Cash received from interest.....	28 65
Cash received from loans.....	511,270 40
	<hr/> \$738,470 06

Contra.

Cash paid loans.....	\$463,283 36
Cash paid drafts.....	224,603 38
Cash paid smelting, freight, copper charges, brokerage.....	38,043 21
Cash paid interest, expense, insurance, storage.....	11,380 42
Cash on hand December 31, 1886.....	1,159 69
	<hr/> \$738,470 06

HURON COPPER MINING COMPANY, ASSETS AND LIABILITIES, DECEMBER 31, 1886.

Assets.

Cash on hand.....	\$1,159 69
Copper on hand, 238,423 lbs. at 10 $\frac{1}{2}$ c.....	25,034 41
Supplies at mine.....	28,085 20
Notes receivable.....	8,090 40
1886, silver (sold).....	160 10
Rock broken in mine ready for hoisting, say 10,400 tons valued at.....	10,000 10
	<hr/> \$72,529 80

Liabilities.

Drafts accepted and in transit.....	\$19,790 02
Loans and bills payable.....	181,028 06
Liabilities at mine.....	26,939 29
Due for smelting and freight.....	4,727 46
	<hr/> \$233,484 83
Less assets.....	72,529 80
Balance liabilities December 31, 1886.....	<hr/> \$159,955 03

To offset which we have machinery, buildings, etc., (exclusive of the mine) valued at \$151,852.71.

AGENT'S REPORT.

HURON COPPER MINING COMPANY, HOUGHTON COUNTY, MICH. }
Houghton, Mich., January 25, 1887. }

D. L. DEMMON, ESQ., *Treasurer.*

Dear Sir :—As the time for making the annual report of the operations and expenditures of this mine has arrived, I beg leave to submit the following, with inventory of supplies, tools, and machinery. Also tabular statements, showing in detail the cost of each department of our work, together with map of the mine, which has been carefully surveyed and plotted, for the year ending December 31, 1886.

SURFACE WORK.

On account of the unprecedented low price of copper that ruled during the summer months, nothing in the shape of improvements has been done in this department. All repairs required have had proper attention, which has kept everything connected with it in good condition.

MACHINERY.

We have not added anything to our plant for the past year ; but it will be necessary for more economical working, to remove at least two of the old "hog nose" boilers at the hoisting engine next spring, and substitute therefor one large fire-box boiler. The cost of making the change will soon be paid for in the saving that will be made in fuel.

STAMP MILL.

We have treated 90,130 tons of rock, which is a falling off of 5,346 tons from the amount treated in 1885 ; which was on account of the breaking of two stamp-shafts and the explosion of one of the boilers, etc. At this writing the mill is in good condition, running regular and doing better duty than at any time for the last six months.

The following openings have been made :

Sunk in shafts.....	312 1-10 feet.
Sunk in winzes.....	216 1-10 "
Drifting	1,381 5-10 "

The total amount of ground broken was 7,170 644-1000 fathoms, or 120,073 tons of rock. The amount of rock hoisted was 129,437 tons, of which 38,943 tons was rejected, or 30 10-100 per cent. of the amount taken out of the mine. The total cost of manipulating a ton of rock hoisted was 1 70-100 dollars.

No. 6 shaft has been sunk from the thirteenth to the fourteenth level. With the exception of a few feet just below the former level the lode in this opening is showing copper in paying quantities. The fourteenth level has been opened fifteen feet south and twenty feet north of the shaft. The lode, at this point, is large and well filled with all grades of mineral. There seems to be a large and good block of ground between this and the thirteenth level which will pay well to remove by stopes. The twelfth and thirteenth levels, north of this shaft, have exposed some good stoping ground. In the latter, for a distance of about one hundred and twenty-five feet, the lode is from thirty to thirty-six feet in width, and carrying some copper throughout. In a winze sinking below the thirteenth level, in this run of productive ground, the lode is showing some good stamp rock and a fair amount of barrel copper. No. 8 shaft has been sunk from

the thirteenth to a point thirty feet below the fourteenth level. For the whole distance the lode is large, and in some places quite rich in stamp rock. The fourteenth level has been opened south one hundred and twenty feet, the greater part of which will pay to stoep. The ground north of this shaft is not showing anything of value. Owing to some of the stopes not producing as well as we had reason to believe they would at the date of our last annual report, and the suspension of the openings last spring on account of the low price of copper, etc., we have not done as well in way of product as we expected. But at this writing everything seems to show, and especially the openings at the bottom levels, that there is something better in store for us. This lode, like all other amygdaloids that have been extensively worked on Lake Superior, will doubtless improve as depth is attained. And all that is necessary to place the Huron on the dividend list is more extensive openings, additional machinery, and a larger output.

Captain T. Whittle and Mr. Alex. Loranger, the clerk, are still with us, and I take pleasure in saying that they have worked earnestly to promote the best interest of the company.

I am, yours respectfully,

J. VIVIAN, *Supt.*

Table of product of Huron mine:

Year.	Tons.	Pounds.	Year.	Pounds.	Tons.
1855.....	3		1871.....	134	1,453
1856.....	12		1872.....	276	1,684
1857.....	35		1873.....	237	1,883
1858.....	24		1874.....	125	1,005
1859.....	22	1,387	1875.....	31	1,289
1860.....	4	1,000	1876.....	31	1,857
1861.....	49		1877.....	41	161
1862.....	69	1,305	1878.....	32	1,100
1863.....	69	206	1879.....	14	1,760
1864.....	50	1,745	1880.....	35	285
1865.....	238	11	1881.....	127	515
1866.....			1882.....	182	579
1867.....	683	1,164	1883.....	360	213
1868.....	740	80	1884.....	963	1,660
1869.....	841	863	1885.....	1,135	1,163
1870.....	42	183	1886.....	996	995
Total.....				7,612	1,556

D. L. Demmon, Sec. & Treas., 19 Congress street, Boston, Mass.; Johnson Vivian, Superintendent, Hancock, Mich.

THE ISLE ROYAL

mine, north of the Huron, remains without change, as does also

THE GRANDE PORTAGE.

I have been through the latter several times and have examined it carefully. I felt satisfied that, opened and worked largely, the mine could be safely operated. That is, it would be sure to pay expenses. Both are in the same lode with the Huron.

THE ATLANTIC MINING CO.

I have written very fully regarding the Atlantic in previous reports, and, as I find nothing new at the mine, all that I can say must be, in the main, a repetition of what I have heretofore stated.

The Atlantic rock yields the lowest percentage of copper of any mine worked in the State. And yet it is operated at a profit—annually returning to the shareholders a dividend. It will be seen by referring to the statement that the average yield of rock for the year was less than $14\frac{1}{4}$ lbs. to the ton, with an average gross value of \$1.53, but it is so mined and manipulated as to leave a profit of 15.3 cents on each ton of rock. The stamp mill expense of $26\frac{1}{2}$ cents per ton is astonishingly low. There is not much of a margin for extravagance and mismanagement in a total cost, mining and stamping, etc., per ton of rock of \$1.38. This includes mining the rock, raising it from 1,000 to 1,300 feet to the surface, tramping to the rock house, breaking it, transporting it $3\frac{1}{2}$ miles by railroad to the lake, stamping and working, taking to smelting mill, smelting, etc.

An examination of the map and the accompanying figures will lead to a clearer understanding of the problem.

ATLANTIC MINE REPORT.

The directors present the following report of operations during the year 1886.

The production of mineral was 4,850,179 pounds, which yielded $72\frac{1}{2}$ per cent., or 3,503,670 pounds of refined copper. The shipments to market during the year amounted to 3,488,790 pounds, for which,—estimating the copper unsold at the close of the year at $10\frac{1}{2}$ cents per pound,—has been realized an average price of 10 92-100 cents per pound.

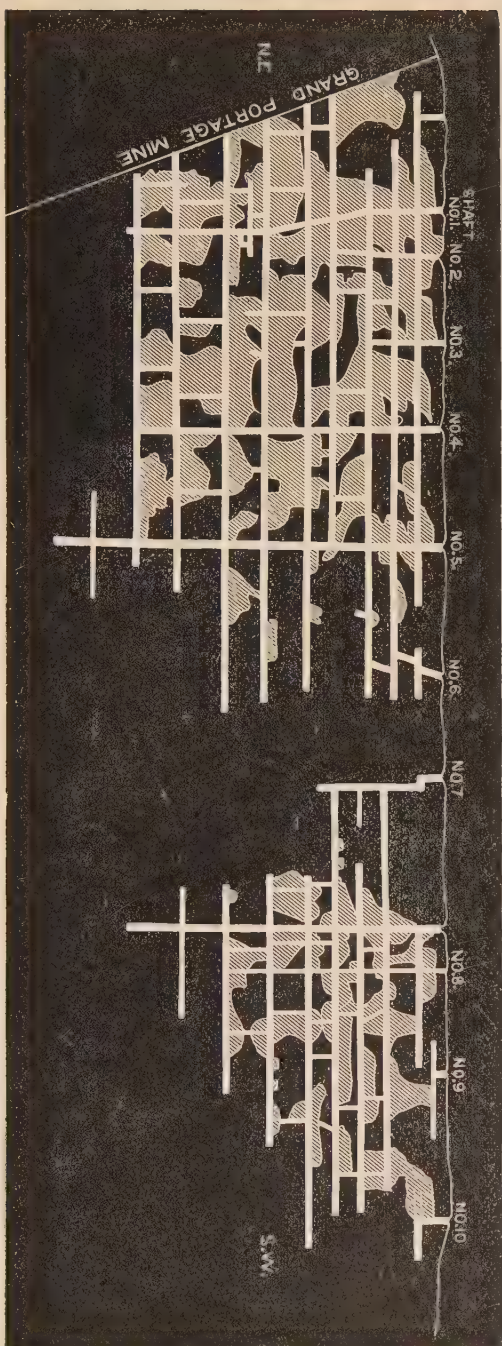
The following is a summary of the year's business :

PRODUCTION.

Copper sold	2,922,996 lbs., av. 11 c	\$321,754 98
" on hand	565,794 " at $10\frac{1}{2}$ c	59,408 87
	3,488,790 lbs., averaging 10 92-100 c.	\$381,163 85
Copper at smelting works Dec. 31st, 1885, 364,981 lbs., valued at 9 cents, net	\$32,848 29	
" " " " " " 1886, 379,861 " " " 8 " "	30,388 88	
		2,459 41
Net value of product of 1885		\$378,703 94
Add balance of interest account		3,640 47
		\$382,344 41

LONGITUDINAL SECTION OF THE ISLE ROYAL MINE, 1897.

Scale, 300 ft. to one inch.



COSTS.

Working expenses at mine as per clerk's tables	\$273,942 04	
Freight	\$13,967 90	
Smelting	36,873 97	
Expenses	6,451 23	
Brokerage	1,609 54	
Insurance	993 95	
Storage	8 00	
	<u>59,904 59</u>	333,846 63
Showing a mining profit in 1886 of		\$48,497 78
There has also been expended for addition to plant, as per detailed statement hereinafter	\$2,294 49	
And for 160 acres of land controlling part of watercourse which supplies the stamp mill with water	<u>4,800 00</u>	7,094 49
Leaving a net gain for the year		\$41,403 29
The surplus from 1885, after payment of dividend, was		262,696 80
Making the net surplus December 31st, 1886		\$304,100 69
as shown in detail in the annexed statement of assets and liabilities, and out of which a dividend of one dollar per share (\$40,000) was paid January 28th, 1887.		

For details of the work performed, and its cost, we refer to the subjoined tables and summary of results. The usual financial statement and report of agent at the mine are also submitted.

JOSEPH E. GRAY,
JOHN J. CRANE,
GEO A. HOYT,
JOHN STANTON,
J. R. STANTON,

Directors.

ASSETS AND LIABILITIES, ATLANTIC MINING COMPANY, DECEMBER 31st, 1886.

<i>Assets.</i>		
Cash	\$18,208 50	
Loans	100,000 00	
Accounts receivable	9,075 52	
Copper on hand, sold, 351,807 lbs	40,011 27	
“ “ “ unsold, 565,794 lbs at 10½ cents	59,408 37	
“ at smelting works, 379,861 lbs at 8 cents net	30,388 88	
	<u>\$257,092 54</u>	
<i>At Mine.</i>		
Cash	\$2,845 25	
Coal	7,201 94	
Wood	12,702 65	
Supplies	26,461 32	
Merchandise in store	35,370 66	
	<u>84,581 82</u>	
Total assets		\$341,674 35
<i>Liabilities.</i>		
Indebtedness at mine	\$13,268 44	
Agent's drafts outstanding	11,774 03	
Accounts payable	12,531 80 ²	
	<u>37,574 27</u>	
Balance of assets		\$304,100 00
Less dividend payable January 28th, 1887, \$40,000.)		

STATEMENT OF WORKING EXPENSES AT THE ATLANTIC MINE FOR THE YEAR ENDING DECEMBER
31st, 1886.*Underground Expenses.*

Sinking 97 feet, averaging \$22.94 net.....	\$2,225 00	
Drifting 3,623.1 feet, average \$4.28 net.....	15,507 17	
Stoping 14,186 92-216 fathoms, averaging \$4.74 net.....	67,260 51	
Timbering, tramming and labor.....	50,282 96	
Timber, materials and supplies.....	8,519 95	
		\$143,795 59

Surface Expenses.

Superintendence, and labor of all kinds, less sundry credit items.....	\$27,623 95	
Supplies and materials.....	4,614 60	
Fuel.....	22,998 55	
Feed for teams, etc.....	1,138 17	
Fire insurance.....	460 00	
Taxes.....	2,676 39	
Canal tolls.....	279 24	
Expenses.....	367 59	
	\$60,158 49	
Less amount received for rents.....	4,153 25	
		56,005 24

Railroad Expenses.

Labor.....	\$5,333 75	
Fuel.....	2,406 50	
Supplies.....	1,282 50	
	\$9,022 75	
Less received for hauling 320 tons freight.....	410 00	
		8,612 75

Stamp Mill Expenses.

Labor.....	\$26,847 45	
Fuel.....	26,329 75	
Supplies.....	10,637 79	
Insurance.....	662 50	
Taxes.....	652 00	
Teaming, mineral, etc.....	398 97	
		65,528 46
Total running expenses.....		\$273,942 04

CONSTRUCTION ACCOUNT.

At Mine.

Four dwellings.....	\$549 40
---------------------	----------

At Mill.

Five slime tables.....	\$1,000 00	
Four iron body jigs.....	420 00	
Addition to house.....	200 00	
Log house.....	125 00	
	1,745 00	
		2,294 49
Total expenditures.....		\$276,236 53

SUMMARY OF RESULTS.

Ground broken in openings and stopes.....	14,724 cubic fathoms
Rock stamped.....	247,035 tons
Product of mineral.....	4,850,179 lbs
Product of refined copper.....	3,503,670 "

Yield of refined copper per cubic fathom of ground broken.....	238 lbs
Yield of rock treated, 14 18-100 lbs. copper per ton, or.....	709 per cent
Gross value of product, per ton of rock treated.....	\$1.5330
Cost per ton of mining, selecting and breaking, and all surface expenses, including taxes,	.8088
Cost per ton of transportation to mill.....	.0348
Cost per ton of stamping and separating.....	1.1089
Cost per ton of freight, smelting and marketing product, including New York office expenses.....	.2425
Cost per ton of working expenses.....	1.3514
Total expenditures per ton of rock treated.....	1.8801
Net profit per ton of rock treated (exclusive of interest earned).....	.1529

AGENT'S REPORT.

Atlantic Mine, L. S., Mich., January 1, 1887.

JOHN STANTON, ESQ., *Treasurer Atlantic Mining Co., New York :*

*Dear Sir :—*The following report of operations at the Atlantic mine for the year 1886 is respectfully submitted :

No. 2 shaft has been extended from the 9th to the 11th level, and put in running order to that point. The 3d, 8th and 10th levels, north of this shaft, have been operated with fair results.

The 5th, 7th and 9th levels have been extended north of No. 1 shaft, and rising stopes have been carried to the line of the shaft. With very little expense this shaft can be put in running order to the 9th level.

No. 3 shaft has been sunk to the 16th level. Drifting and stoping has been done in the 12th, 13th, 14th, 15th and 16th levels north, and the 15th and 16th levels south of the shaft.

No. 4 shaft has been put in running order from the 13th to the 14th level. Drifting and stoping has been done in the 10th, 11th, 12th, 13th and 14th levels south of this shaft. As we extend 1,000 feet south of this shaft, the lode seems to get leaner, and will not pay to operate.

The shafts and pumping machinery are in very good working order.

The map shows the extensions of the workings to date. You will notice that the 12th and 13th levels have passed the line of No. 2 shaft, and it is necessary to operate these levels through this shaft, and also the 3d, 5th and 7th levels through No. 1 shaft in order to save the expense of trammig the rock so great a distance through these long levels.

STAMP MILL.

The stamp mill has been operated very successfully. The rock has been treated cheaper than in any previous year.

Considerable repairs and additions to the dressing machinery have been made during the year. Some of the old wooden jigs have been removed and replaced with new iron ones, and four new iron ones added. Ten of the slime tables, which have worked for years and become unfit for use, were taken out and replaced with ten new double tables, having about double the capacity of those removed. A launder 1,000 feet long and twenty inches wide has been laid to convey the waste sands towards Cole's creek, and prevent the sand running so far out in the old channel.

The mill is in very good condition and capable of treating more rock than we can possibly give it with our present hoisting capacity.

RAILROAD.

The railroad has been operated very successfully. The cost of transporting the rock to the mill was only 3.48 cents per ton. The road and rolling stock is in fair condition. There were 1,830 new ties put in during the last season.

MACHINERY.

The plant at the mine has done the work very satisfactorily. It has become necessary to operate No. 1 shaft, and to do so we shall have to extend the trestle road from No. 2 to No. 1 shaft, about 800 feet. This road will then convey the rock from these two shafts to the rock-house. The trestle-road will also have to be extended about 600 feet, connecting No. 3 with No. 4 shaft, and this road will take the rock from these shafts to the rock-house.

I would refer you to the tables made by Mr. Van Tassel, which show the cost in every department, and also the map filled out to date.

Allow me to recommend to your favor the different officers who have labored faithfully for the best interests of the company.

Yours truly,

WM. TONKIN, *Agent*.



The following table gives the important results of the mine's operations for the past 11 years:

	1875.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.
Number of tons of rock stamped.....	80,000	96,696	105,730	121,709	112,668	169,185	176,555	189,800	195,669	209,510	241,010	247,035
Yield of ingot per ton, in pounds.....	19.58	18.99	19.42	18.50	19.00	14.27	14.36	13,866	13,708	15.1	14.86	14.18
Number of fathoms broken in mine.....	5,628	6,550	7,091	8,299	8,665	9,929	9,240	10,170	11,163	12,210	13,403	14,724
Yield of ingot per fathom, pounds.....	278	280	280	243	266	244	2,735	259	240	259	267	238
Cost in cents per ton for stamping and washing.	87.96	67.09	57.79	48.85	42.44	38.13	42.54	37.07	35.35	39.95	30.36	26.53
Total cost per ton of rock mined, etc.....	3.90	3.58	3.08	2.78	2.33	2.25	1.96	1.9082	1.7789	1.71	1.436	\$1.3801
Total average cost per pound, ingot.....	\$0.2212	\$0.1895	\$0.1637	\$0.1683	\$0.1220	\$0.1584	\$0.1368	\$0.1373	\$0.1256	\$0.1087	\$0.936	\$0.0908
Average price per pound received for copper.....	.2247	.2135	.1854	.1615	.1630	.1997	.1712	.1756	.1500	.1181	.1116	.1092
Dividends paid.....	.....	.....	.....	20,000	30,000	40,000	80,000	80,000	40,000	20,000	40,000	40,000
Net profit per ton of rock.....	.....	.44	.51	1.01	.87	.5000	.4711	.4958	.2483	.0919	.2205	.1529
Per cent of copper in rock.....	.976	.949	.971	.925	.95	.713	.718	.693	.685	.755	.743	.709

The following table gives the product for each year:

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1866.....	6	1,475	1877.....	1,027	304
1867.....		1,760	1878.....	1,132	1,592
1868.....	764	258	1879.....	1,152	1,822
1869.....	823	857	1880.....	1,170	1,195
1870.....	186	617	1881.....	1,264	9
1871.....			1882.....	1,315	1,708
1872.....			1883.....	1,341	197
1873.....	431	1,336	1884.....	1,586	1,585
1874.....	686	403	1885.....	1,791	533
1875.....	783	1,036	1886.....	1,751	1,670
1876.....	917	1,041			
Total.....				18,130	1,431

John Stanton, Treas., New York; Wm. Tonkin, Agent, Houghton, Mich.

THE ONTONAGON DISTRICT

presents little that is new to record. I have written very fully of this section of the copper region heretofore, and have taken occasion to express myself very favorably regarding it. I see no reason to retract, or to in any way modify what I have formerly said as to my belief in its metallic richness. Sometime, when the country is more accessible, when there is greater interest in copper discoveries, Ontonagon county will again come to the front as an important mining district.

Just now, also, some interest is taking in the Iron River Silver District, which ten years ago was very active. All work was suddenly abandoned in about 1877, and nothing has since been done. These silver deposits were described in the Commissioner's Report for 1877-78. A few tons of the rock have been sent to Chicago to be treated, and the result is awaited by the parties interested. The Gogebic Iron Range was formerly embraced in Ontonagon county, but was recently detached by the last Legislature to form the new county of Gogebic.

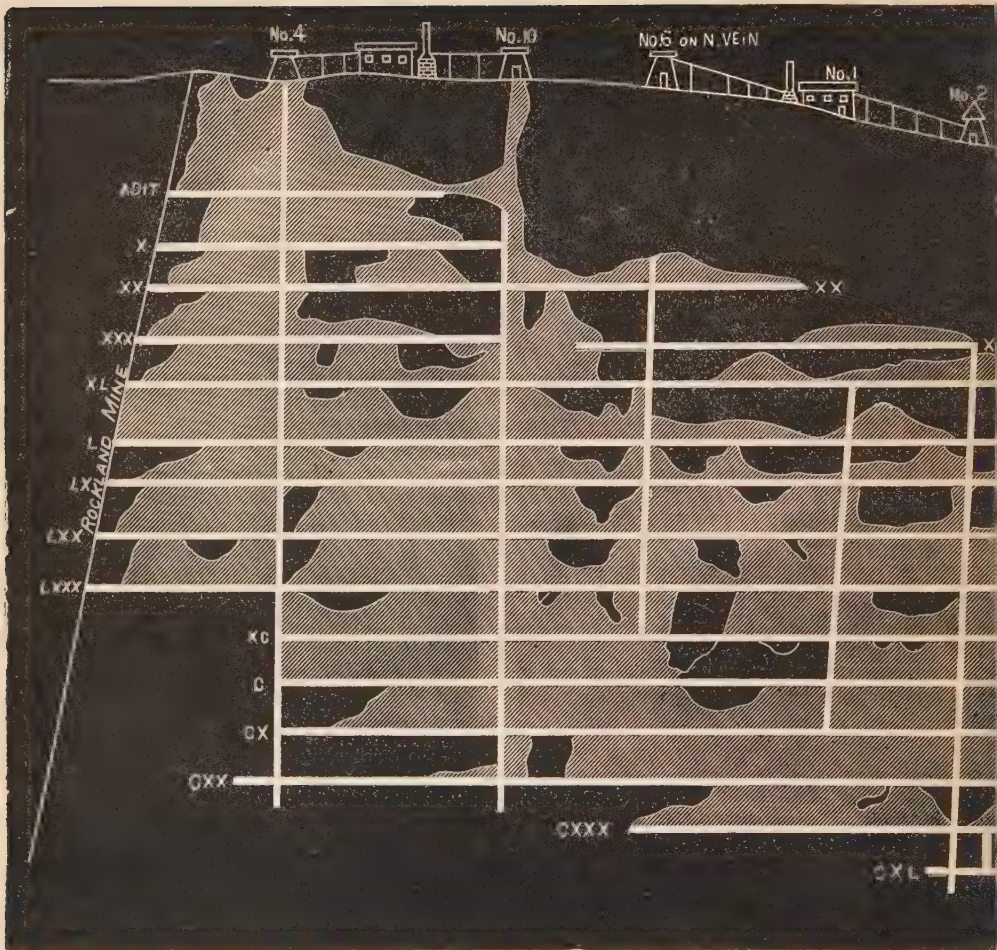
The most important of the Ontonagon mines is

THE NATIONAL,

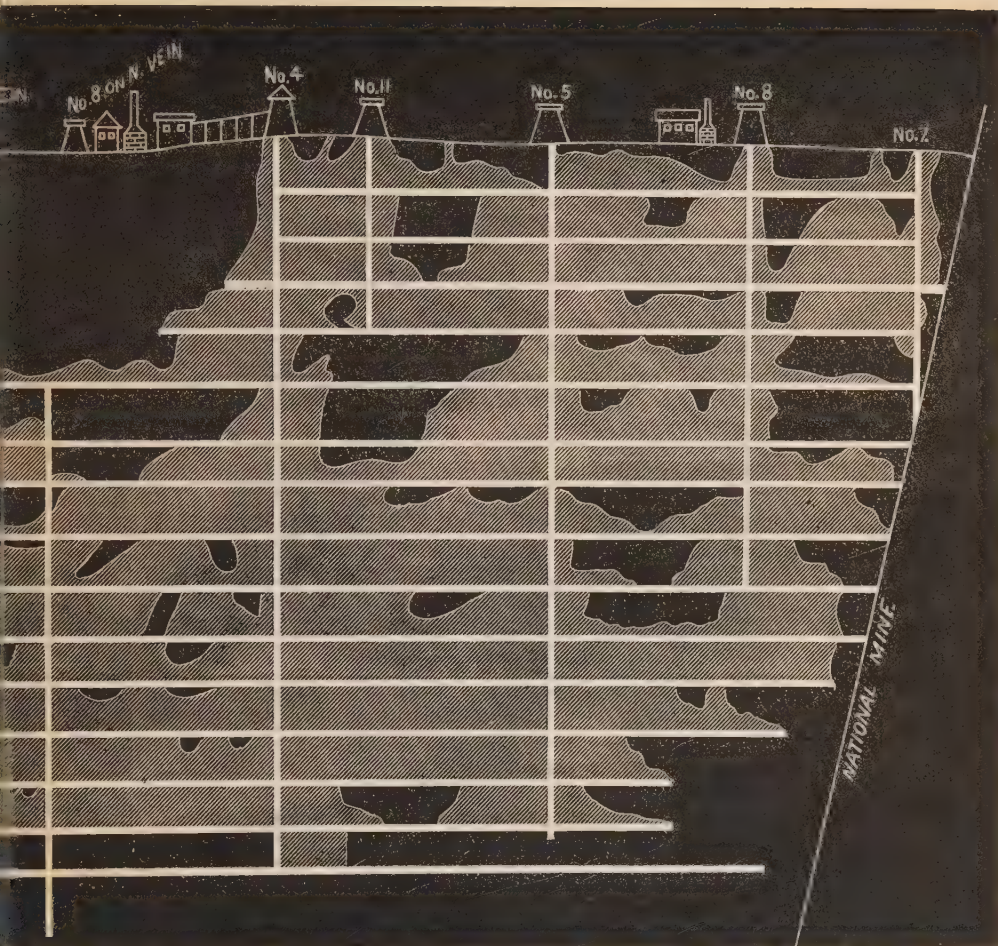
which now includes the once famous Minnesota, also. They are contiguous mines, the openings, even, intersecting one another. The National company has been engaged during the past year in driving an adit from the Ontonagon

LONGITUDINAL SECTION C

Scale, 80'

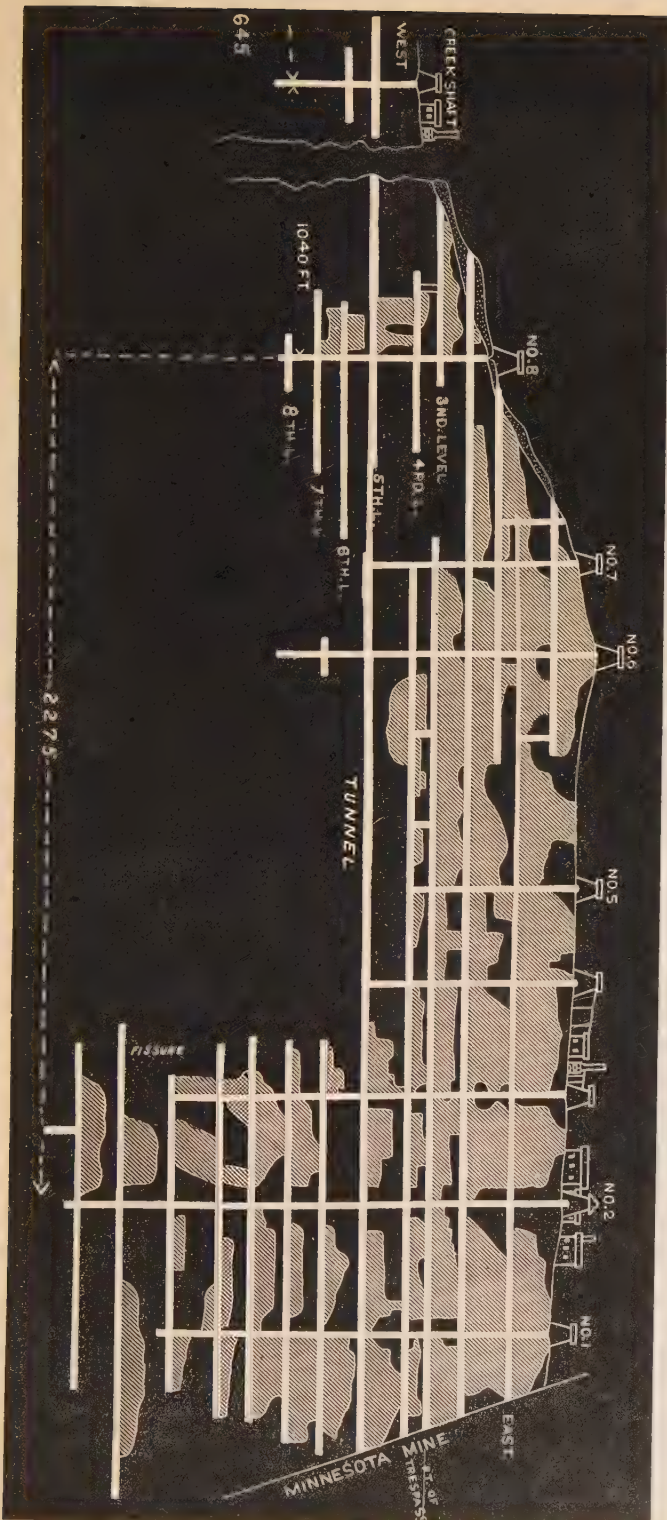


THE MINNESOTA MINE, 1887.
one inch.



LONGITUDINAL SECTION (F THE NATIONAL MINE, JAN., 1887.

Scale, 100 ft. to one inch.



river through the mine. The purpose and location of this tunnel is fully explained in my last report. It is now about completed. The greatest difficulty has been experienced in making the final connection between the entrance portion and the creek shaft. Instead of its being rock, which would have given little trouble, the ground is sand, gravel, boulders, and quicksand. Sometimes it would run clear to the surface, letting in the water of the creek and everything else upon the men and work. This trouble happened several times through the effects of blasts.

The rate of driving has been rapid. It may be briefly stated as follows: Commencing June 1, 1886, since which time hoisting and pumping machinery have been set up at the creek, and at No. 8 shafts, and both shafts have been freed of water and repaired, and 500 feet of skip road put in No. 8, and 3,900 feet of tunnel completed May 1, 1887. The whole length of tunnel from the western extremity easterly to No. 2 shaft, is 3,950 feet. With the exception of the west 640 feet, it is driven in the conglomerate vein, starting in the face of the bluff 188 feet above the river, and about three-fourths of a mile distant from it.

It is, of course, on a uniform grade. The rock driving was done with power drills, of which six were used until some of the connections were made. The compressor is in the stone building near No. 2 shaft, and the air was carried in the pipes from there to the point of attack. The main pipe from the compressor is 3" diameter, and is placed along the surface to creek shaft; thence the pipe used is 1½" diameter. The expansion points are put in at intervals of 500 feet, and notwithstanding they had nearly a mile in length of pipe along the surface, with offsets at every point, aggregating, before they finished much more than the extent of surface pipe, there was not at any time any delay, at any point, by reason of interruption of the flow of air. Four blowers, driven by steam, were used to aid in ventilation, in the long drifts.

The average number of men employed was 52, all told. No stoping was done on the line of the tunnel, though some apparently good ground was cut through. About 15 tons of copper were obtained in the work. The average dimensions of the transverse section of the tunnel are eight feet high and seven feet wide.

The work now will be to cross-cut the ground between the adit and the amygdaloid belt described in previous reports. Capt. Parnell is now, May, driving a cross-cut, starting from the adit near old No. 6 shaft, and another between it and No. 2 shaft. When the cross-cuts are completed, the amygdaloid will be driven in east and west 1,200 feet, in the same horizon as the adit.

The amygdaloid is a stamp lode, and so far as it has been proved, is a good

one. If it continues to show up favorably, as it probably will, the future of the National will be assured. A stamp mill of the modern class will be required, and the National will again merge into the ranks of first-class mines.

I believe that there is still a prosperous future in store for the National. The plan of the management, as now carried out, is to prove the mine, to make sure that there is plenty of good milling rock in the mine before going to any larger expenditure in plant.

The adit gives a "back" of over 500 feet for a length of 2,600 feet. All the material will find an outlet through the adit to the river, where the mill will be built. There is no doubt that if copper were at the price it usually holds, it would be safe to predict the work for the coming year; but, certainly, there is not much encouragement to push things at a copper mine when the circumstances are as at the National.

Capt. Wm. E. Parnell, who took charge of affairs on the resumption of work six years ago, still continues Superintendent. D. L. Demmon, Secretary and Treasurer.

The National has produced, in the aggregate, 5,449 tons 1871 lbs. of refined copper.

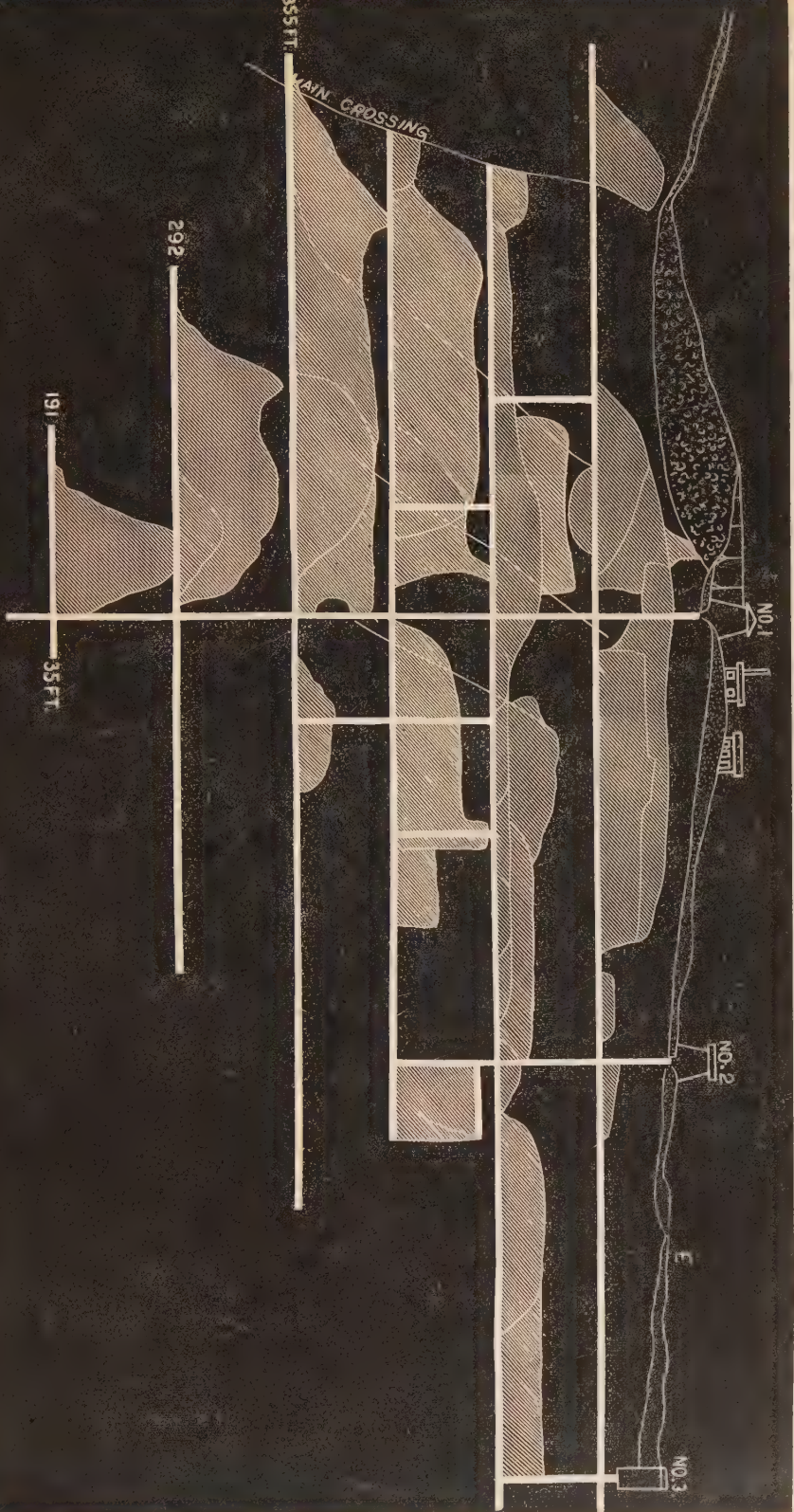
THE MASS MINING COMPANY

continued to operate its mine on company account, until September, 1884, when it was leased by Mr. Benj. F. Claymouth *et. al.*, who worked it under the title of the Mass Tribute Company, until the spring of 1887, when they shut down and ceased work altogether. They could not make any money with copper at 10 cents a pound. The Mass has of late years been well managed, having been of late years in the hands of one of the most intelligent and experienced miners in the country. But it is too small a mine, and worked on too limited a scale, to achieve any great success. It should be combined with the Knowlton and with the Ogima. I explained all this very fully in my last report, and it is not necessary to reiterate here my former statements.

The work at the Mass has demonstrated the great value and the characteristics of one of the important copper-bearing belts of the Evergreen Range, the knowlton vein, and the experience thus here obtained, will be of great value in other mines in all future working.

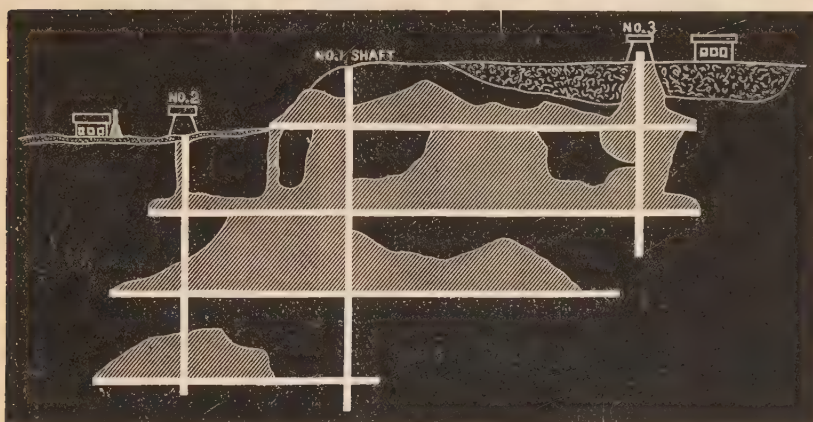
LONGITUDINAL SECTION OF THE MASS MINE, JAN., 1887.

Scale, 120 ft. to one inch.

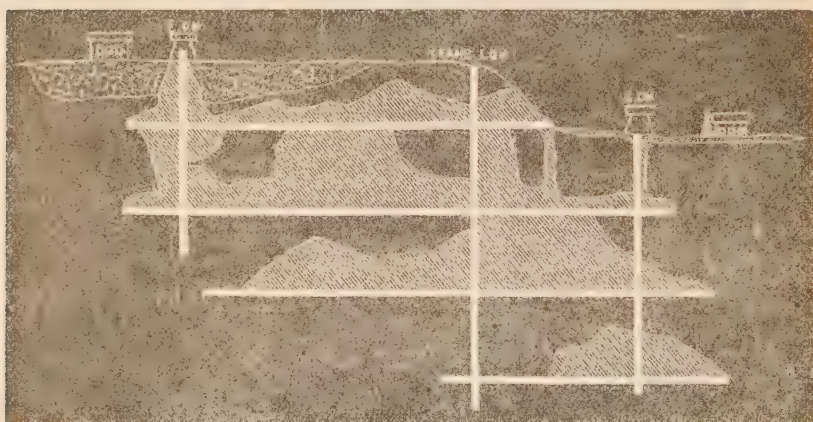


LONGITUDINAL SECTION OF THE KNOWLTON MINE, 1887.

Scale, 180 ft. to one inch.



LONGITUDINAL SECTION OF THE KNOWLTON MINE, 1887.
Scale, 180 ft. to one inch.



LONGITUDINAL SECTION OF THE EVERGREEN BLUFF MINE, 1887.

Scale, 250 ft. to one inch.

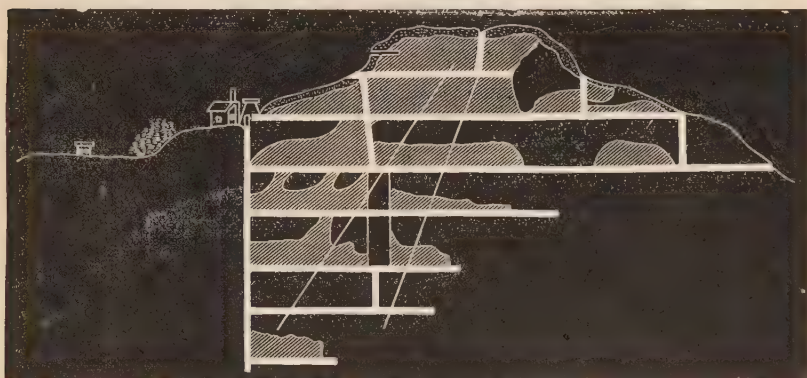


Table of product of Mass mine:

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1857.....	8	228	1872.....		1,403
1858.....	6		1873.....	4	265
1859.....	26	682	1874.....	5	1,925
1860.....			1875.....	1	1,014
1861.....			1876.....	40	1,952
1862.....			1877.....	54	238
1863.....			1878.....	206	339
1864.....	4	1,452	1879.....	228	294
1865.....	6	996	1880.....	258	1,159
1866.....	5	112	1881.....	233	1,684
1867.....	5	40	1882.....	368	1,446
1868.....	9	939	1883.....	329	1,474
1869.....	1	1,213	1884.....	281	718
1870.....	1	1,408	1885.....	181	1,500
1871.....	9	692	1886.....	123	1,179
Total.....				2,403	786

In the

KNOWLTON

and other of the Evergreen Range mines, the usual amount of tributing has been done, with the customary results.

THE RIDGE COPPER COMPANY.

The year's work at the Ridge is set forth in the following report. The description of the mine, etc., I have given as fully as necessary in former reports.

Table of product of the Ridge mine:

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
1855.....	30		1871.....	175	150
1856.....	35	631	1872.....		
1857.....	36	1,874	1873.....		
1858.....	29	790	1874.....		
1859.....	39	690	1875.....		
1860.....			1876.....		
1861.....			1877.....		
1862.....			1878.....		
1863.....			1879.....		
1864.....	8	917	1880.....		
1865.....	85	433	1881.....		
1866.....	71	711	1882.....		
1867.....	94	1,537	1883.....		
1868.....	86		1884.....		
1869.....	126	1,840	1885.....		
1870.....	122	1,700	1886.....		

RIDGE MINE REPORT.

The product of the mine for the year 1886 has been:

Barrel copper.....	147,413 lbs.
Mass copper.....	64,902 lbs.
	212,315 lbs., or 106 315-2,000 tons.

Which has realized..... \$17,188 75

The expenditures for the year have been:

Mine expenses.....	\$14,471 65
Other expenses as per treasurer's account.....	4,928 72
	\$19,400 37
From which deduct total receipts.....	17,188 75
Loss on business of the year.....	\$2,211 62
The statement of assets and liabilities in last report showed a balance of.....	\$7,419 05
Assessment called.....	9,938 50
	\$17,357 55
Deduct loss on business of 1886.....	2,211 62
Balance on January 1, 1887, as per statement.....	\$15,145 93

BALANCE SHEET FROM THE BOOKS OF THE RIDGE COPPER COMPANY, JANUARY 1, 1887.

Expenditures.

Real estate—cost of property.....	\$203,541 00
Expenditures as per published statement to January 1, 1886.....	1,123,574 81
	1886.
Mining account.....	\$13,531 11
Smelting.....	1,539 27
Expenses, taxes and copper charges.....	2,486 24
Transportation.....	903 21
	18,459 83

Dividend account:

Paid February 24, 1873	\$50,000 00	
Paid February 23, 1874	20,000 00	
Paid February 8, 1875	20,000 00	
Paid February 10, 1880	9,784 50	
		99,784 50

Company's stock, costing..... 304 40

Treasurer's account—cash on hand..... 15,460 00

\$1,461,124 54

Receipts.

Capital stock :

Paid in for property	\$200,000 00	
Assessments	219,938 50	
		\$419,938 50

Copper account :

Sales to January 1, 1886	\$1,007,361.87	
Sales in 1886	17,188 75	
		1,024,550 12

Interest account :

Collected to January 1, 1886		16,635 92
		\$1,461,124 54

Shipments in 1886..... 212,315 lbs.

Yield..... 74.551 per cent.

Ingots..... 158,272 lbs.

STATEMENT OF LIABILITIES OF THE RIDGE COPPER COMPANY, AND OF AVAILABLE ASSETS, JANUARY 1, 1887.

Liabilities.

Dividends unpaid	\$215 50
Drafts outstanding	1,416 04
Balance	15,145 93
	\$16,777,47

Assets.

Treasurer's account	\$15,460 00
Cash on hand at mine	72 01
Supplies at mine	1,245 46
	\$16,777 47
Balance of available assets over liabilities	15,145 93

AGENT'S REPORT.

RIDGE MINE, Feb. 1, 1887.

Philip Highley, Esq., Secretary and Treasurer.

Dear Sir :—Herewith I submit a report of operations at the mine for 1886, with statement of accounts, inventory of supplies, tools, machinery, etc.

Tribute work has been continued during the year with satisfactory results. The production has been 106 tons of copper, all of which has been shipped to the Detroit smelting works, and consisted of one hundred and forty-three (143) barrels and eighty-nine (89) masses of copper.

On May 1 the tributers hoisted their copper, cleaned it and weighed it in to the company. I purchased from them one hundred and one thousand four hundred fifty-nine (101,459) pounds copper at a cost of \$4,228.67.

Most of the miners went to work again on tribute until October 1, when their copper was again hoisted, cleaned and weighed, and they delivered to me 110,856 lbs. at a cost of \$5,507.05. The total amount purchased of the tributors for the year was 212,315 lbs., of this amount 176,304 lbs. cost 5 cents per lb.—\$8,815.20, and 36,011 lbs. at $4\frac{1}{2}$ cents—\$1,620.50, or a total of \$10,435.72.

On November 1 I again let tribute for the winter months at $4\frac{1}{2}$ cents per lb. upon conditions, however, that if the copper they produced sold for 12 cents per lb. they should receive 5 cents per lb., the former tribute price.

We have now 16 miners at work on tribute, and I estimate that they have taken out about 18 tons of copper so far this winter, and I estimate we shall have between 40 and 50 tons to ship in May.

The great bulk of the copper taken out by tributers the past two years, has been taken from the old abandoned ground at and above the thirty fathom level, in ground long since abandoned by the former manager of the mine. It has also come almost exclusively from the west end of the mine. This would seem to prove beyond a shadow of doubt that there is a rich shoot of copper ground from the surface downward.

It would seem that one of the first efforts of the company should be to sink the No. 1 shaft from its present bottom in the 10 level to the 50 level at least, and extend the 20, 30, 40 and 50 levels in the western boundary line to the Evergreen Bluff mine. As near as I can estimate these levels can be driven yet from 150 to 250 feet to reach the boundary line. The shaft could be sunk very rapidly by sinking and rising from the different levels, and very cheaply, too, as the ground is of such a nature as to permit of being drifted and blasted easily. The sinking of this shaft would enable us to open a large body of ground, keep a moderate force of miners at work several years, and produce many hundreds of tons of copper.

Great care has been taken during this tribute work to see that no injury has been done to the mine, its shafts, or the accumulation of rock in any of the drifts.

During the year considerable work has had to be done in replacing old and decayed timber in the shafts, drifts and stulls. It was also found advisable to make new gutters in the adit level, and clean away considerable dirt and rock so as not to prevent the drainage of the mine, and stop any water flowing into the mine from the surface. The cost of the work was \$250.

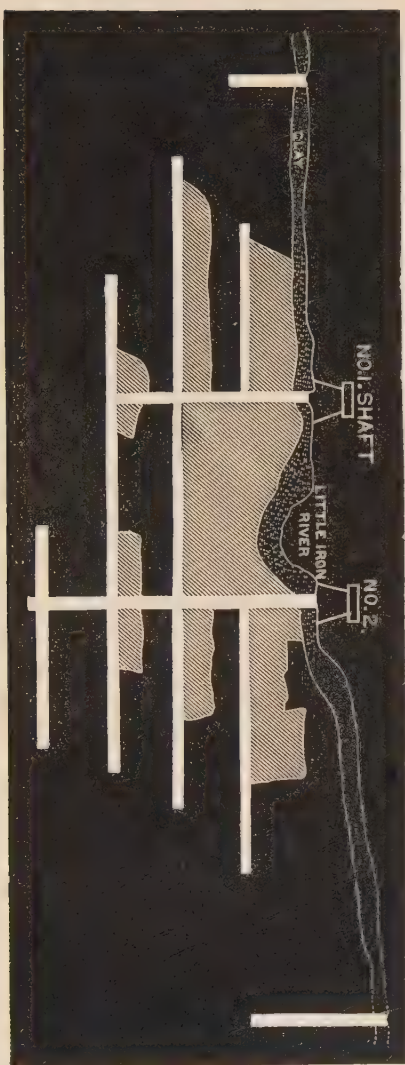
During the summer I made a thorough exploration of the property so as to locate the five veins supposed to cross it. The five veins are known as the Evergreen, Ogima, Butler or Champion, Mass and Knowlton veins; they were all found, located and opened on. The exploration was confined to the western portion of the bluff where our present mine is opened.

The Evergreen vein is the one on which our present mine is opened on, and has been wonderfully productive of mass and barrel copper wherever worked. The distance from this vein, north, to the Ogima vein is 260 feet; from the Ogima to the Champion or Butler vein is 100 feet; from the Champion to the Mass vein 300 feet; from the Mass to the Knowlton vein is 140 feet. Thus we find we have on the property, within the space of 800 feet, five distinct copper bearing veins, all of them locally known to be rich in copper, and all of them could be reached and worked through the present mine by driving a cross-cut north from one of the lower levels, which I have no doubt will eventually be done. The cost of the exploratory work was \$178.20.

Owing to the improved outlook of the copper market and the advance in the price of copper last fall, I started to unwater the mine. From the start we were beset with

LONGITUDINAL SECTION OF THE NONESUCH MINE, 1887.

Scale, 200 ft. to one inch.



many drawbacks, delays and obstacles, the facilities for the work were not at hand, the machinery was out of order ; but we finally got to work, the mine is now unwatered below the 50 level in the No. 2 shaft, but owing to a difference in the level (of which I was not aware) between the No. 2 and 3 shaft the drainage is west of No. 2 instead of east, as it is in all the levels above, so that there is water in 50 level west of the No. 2 shaft, but it will take but a few days in the spring to take it out. If thought advisable the water then can soon be taken out of the 60 and 70 levels through the No. 3 shaft. We have sufficient dry wood left over for the work, and everything is ready. The cost of this work, repairs to machinery, wood, etc., was \$730.10 ; this includes, however, about 40 cords of dry wood at the engine house.

In December the east side of No. 2 shaft between the 10 and 20 levels came in and put a stop to our work of unwatering the mine. The timbers used were hemlock and were completely rotted, and the only wonder was that they lasted so long. Considerable difficulty was experienced in clearing and keeping away the rock, but heavy cedar timbers were put in and a good substantial job done. The cost of this work was \$181.

I would advise the continuance of tribute work, for the reasons before given, that it helps to keep the mine open. The mining captain is continually underground, and much of the time is employed in keeping everything in repair and good shape.

If, however, the condition of the copper market should improve, and promise a reasonable price for copper. I renew my advice to prepare ourselves for it by equipping the mine with modern machinery, power drills and other appliances to enable us to mine readily and cheaply procure copper.

In the meantime it will be my aim to keep the mine, and everything on the surface in good repair and condition, ready to commence work at any time.

Very respectfully,

ALFRED MEADS, *Superintendent.*

THE BELT COPPER COMPANY, LIMITED.

There is nothing new to record regarding the Belt. The mine and property are in charge of Hon. James Mercer, agent and resident director, Ontonagon, Mich.

This mine was the subject of much interest a few years ago from several causes, prominent among which was the high standing of the gentlemen who inaugurated the new enterprise. The parties who organized the company are Englishmen, and the general office is in London.

For upwards of a year past the mine has not been worked. The company paid for the mine in 1882, in cash, \$121,500 ; in fully paid up shares \$680,400 —\$801,000. Since which time there has been expended upwards of \$400,000.

The amount of copper produced is as follows:

Year.	Tons.	Pounds.	Year.	Tons.	Pounds.
Prior to 1882.....	216	475	1884.....	89	351
1882.....	2	1,624	1885.....	13	1,433
1883.....	8	402	1886.....	3	1,486
Total.....				335	1,772

THE JOHN DUNCAN LAND AND MINING CO.

has a large body of mineral lands that are esteemed valuable. These lands are mostly in Ontonagon county, in the Gogebic range. They are offered for sale or to lease.

Daniel Kloeckner, Secretary, Hancock, Mich.

COPPER PRODUCTION OF THE WORLD.

The following figures are taken from a recent publication by Henry R. Merton & Co., London, Eng.

They give as the record of the output of the world for the last eight years, taking alone the three greatest producing countries.

The figures are in gross tons:

	United States.	Chili.	Spain and Portugal.
1879.....	23,000	49,318	33,361
1880.....	27,009	42,916	36,313
1881.....	32,000	37,989	39,258
1882.....	40,467	42,909	39,560
1883.....	51,547	41,099	44,607
1884.....	63,555	41,648	46,515
1885.....	74,053	38,500	47,873
1886.....	69,809	35,025	49,653

Since 1883 the United States occupy the position, undisputed, of being the greatest copper producing country of the world. Since 1879 the output has tripled, while that of Spain has increased only 50 per cent., and the make of Chili has considerably declined.

For the last three years the output of the different countries of the world has been as follows, the figures for 1884 and 1885 being those of Henry Merton & Co., modified by the United States geological survey, and those of 1886 being the data collected by the former:

Countries.	1886.	1885.	1884.
EUROPE.			
Great Britain.....	2,500	2,773	3,350
Spain and Portugal—			
Rio Tinto.....	24,700	23,484	21,564
Tharsis.....	11,000	11,500	10,800
Mason & Barry.....	7,000	7,000	7,500
Sevilla.....	2,135	1,800	2,000
Portuguesa.....	1,258	1,665	2,300
Other mines.....	3,500	2,424	2,251
Germany.			
Mansfield.....	12,595	12,450	12,582
Other German.....	1,870	2,800	2,200
Austria.....	550	585	670
Hungary.....	700	800	800
Sweden.....	600	775	662
Norway.....	2,220	2,560	2,706
Italy.....	900	835	1,325
Russia.....	4,875	5,100	4,700
Total Europe.....	79,463	76,551	75,410
NORTH AMERICA.			
United States.....	69,805	74,053	63,555
Canada.....	2,000	2,500	2,236
Newfoundland.....	1,125	778	668
Mexico.....	850	375	291
Total North America.....	73,780	77,706	66,750
SOUTH AMERICA.			
Chili.....	35,024	38,500	41,648
Bolivia.....	1,100	1,500	1,500
Peru.....	75	229	362
Venezuela.....	3,708	4,111	4,600
Argentine Republic.....	180	233	259
Total South America.....	40,088	44,573	48,269
AFRICA, ASIA AND AUSTRALIA.			
Algiers.....	110	250	260
Cape of Good Hope.....	6,015	5,450	5,000
Japan.....	10,000	10,000	10,000
Australia.....	9,700	11,400	14,100
Grand total.....	216,156	225,930	219,785

GOLD.

GOLD.

A great impetus has been given to the explorations for gold by the development at the Lake Superior find in section 35, N. W. $\frac{1}{4}$ of T. 48, R. 28. Some very rich rock was found here two years ago that created no little excitement. Recently again some further work has developed still better results.

Mr. Julius Ropes, of Ishpeming, makes the following report regarding an examination by himself of some of this rock :

C. H. HALL.

Dear Sir :—I have completed the examination and assay of the average sample (12 oz.) of the rich gold quartz we selected at the company's office the 7th inst. and herewith give the result :

The 12 oz. were pulverized and an average taken out for assay, and the gold pounded out of the balance.

The assay gave 2,446.99 troy bullion per ton of ore. The bullion is 863 fine, gold, 137 fine, silver. This gives 2,112.35 oz. gold per ton, silver 334.64.

Value of gold at \$20.67 per oz.....	\$43,662 27
“ “ silver “ .95 “ “	317 90
Total value per ton ore.....	<u>\$43,980 17</u>
Value of bullion per troy oz. gold.....	\$ 17 83
“ “ “ “ “ silver	14
	<u>\$ 17 97</u>

The gold from the portion assayed added to the amount pounded out (less 12 grains chipped off for assay) gives button of bullion herewith enclosed weighing 346 grains, 301 grains gold and 45 grains silver.

Value of gold in button.....	\$12 96
Value of silver in button.....	10
Total value of button	<u>\$13 06</u>

Very respectfully,
J. ROPES.

This rock is obtained in a fissure vein at a depth 22 feet from the surface. The vein matter has a width of about $3\frac{1}{2}$ feet which includes the slaty incasings of the quarter.

The land is owned by the Lake Superior Iron Co.

C. H. HALL, *Agt.*

ANNUAL REPORT OF THE
THE ROPES GOLD MINE.

I went underground through the Ropes mine about the middle of April and it impressed me very favorably. The quartz vein is well defined and persistent. Certainly the mine could furnish far more rock if there were facilities for working it up.

The mine is to the 7th level 380 feet deep. First level has been opened 76 feet W. and 145 E. of shaft, 2d level 54' W. 135 E., 3d level 87' W. 133 E., 4th level 25 feet W. 195 E., 5th level 96 W. 168 E., 6th level 15 W. 96 E., 7th about 10 feet each way from the shaft and 7 feet wide. The richest pocket found was in the 1st level, which showed considerable free gold. I extract from the last annual report of the superintendent, S. S. Curry. The entire report is of interest, but I omit all but the most essential facts.

A peculiarity of the ore bodies on the several levels, is their continuance on the foot wall 40 to 80 feet east, terminating in slate, then shifting to the south contact where there are uniformly reached by a cross-cut from 12 to 18 feet, the intervening ground of slate and quartz being a good milling ore. A reference to the vertical and horizontal plan of the mine by the captain, *herewith shown*, clearly indicates their position.

It is estimated that not to exceed one-third of the ground opened up has been stoped out on the series of lenses thus far worked upon, and that there stands in sight that cheaply and safely mined, as estimated by Capt. Trevarthen, above the 5th level. 38,000 tons.

While but little work or exploration has been done to prove the extent of paying ore bodies both north and south of the present workings, indications show their existence in considerable quantities all through the mine. A cross-cut was driven south from the vein 133 feet east of the shaft on the 3d level (shown on the plan), 43 feet through slate and quartz, the former assaying \$10 to \$15 in gold, the latter showing coarse free gold running very high. If this condition exists on ore level, it is reasonable to expect that the same horizon on the others will give as good results. The shaft has been sunk 92 feet since the date of last report.

The number of feet of winzes sunk between the several levels is 50. Number of feet of drifting, including cross-cutting, 747.

The only explorations done on the surface was the sinking of two pits in the swamp, 800 feet east of the Curry shaft on the strike of the lode. Owing to the influx of water and the lateness of the season the work was discontinued.

In the way of surface improvements there has been added to the plant and mine equipment, for the payment of which funds were provided by an assessment of 10 cents per share on the capital stock, levied by the board of directors in April last, one 80-horse power boiler, 1 Merritt's 6 feet hoisting drum, 1 Duplex Rand air compressor, capacity 4 power drills, 4 Rand power drills, 5 Tullock automatic ore feeders, 700 feet of wire rope, 1 exploding battery, besides many other appliances.

There has been built one dry house, 12x20 feet, hoisting drum house, 20x25 feet, one blacksmith and carpenter shop, 20x40 feet, addition to and raising boiler house, 20x48 feet, one barn, two stories, 20x24 feet, sided and repaired frame house, house purchased, 20x25 feet, of Julius Tallene, boarded and roofed shaft house.

The additions to the plant for mill and mine have required considerable expenditure

of labor and money to place in position and working order, but their advantage is shown in the rapidity with which developments have been carried forward in the mine, keeping in reserve large blocks of ground. The mine is in excellent condition and the reserves can be very cheaply extracted. This factor must be borne in mind and a portion of the year's expenditure credited with these reserves.

Early in the season the management contemplated several modifications, changes and improvements in the mill. These have been carried into effect as time and opportunity would allow. Most of them are completed and at a small cost. An increase in the amount of ore crushed has been the great desideratum. It has been accomplished, and we are now crushing from 33 to 35 tons to-day, against 17 tons a year ago—results that correspond to mills elsewhere when it is considered that we crush our ore much finer, using a 50-mesh screen, our gold, being finer, requiring it.

The first week in July, owing to the excessive and unprecedented drouth, the sources from which a sufficient supply of water had been obtained gave out, causing a stoppage of the mill for a time. Steps were immediately taken to bring in two small rivulets rising in a series of hills a mile or so to the west of the mill. Dams were built at a point on them which would give a head of 18 feet, which would bring it over an intervening hill and drop it into the swamp to the west of the mill; 1,200 feet of 3-inch pipe was laid west from the outlet, and the dams connected with this by 700 feet of 2-inch and 800 feet of 2½-inch pipe. Work was started on the 8th and the water got to the mill on the 18th, causing a suspension of ten days of milling. But for the supply from this source the mill could not have been run two months since July 1.

Number of men employed has averaged 49 per month.

With the promising condition of the mine, and the increased capacity of the mill, the outlook is more promising for the future.

The loss in the tailings ranges from 95 cents to \$2.50 per ton, according to the grade of ore, averaging \$1.90 per ton, 80 or 90 per cent. of the value being gold.

We have crushed 6,959 tons the past year, giving a product as shown by the secretary's report.

Our mining captain, Mr. Trevarthen, and mill superintendent, Mr. Weatherston, have been untiring in their efforts to make their respective departments a success, and profitable to the company.

As a summary of the above facts the following is pertinent :

With the existence of large bodies of ore below the present levels as proved by the shaft, the body between the 5th and 6th levels, not included in the estimate, which are in sight (no winze between to the east as yet), a much larger reserve stands in the mine than the 38,000 tons reported, the larger part of which has been developed by the expenditure of the past year. While a year ago small bodies were in sight with promising indications, they remained to be proved up. The 38,000 tons at least should now be credited as a resource at \$1 to \$2 per ton net.

Though a close estimate of the value of these bodies, say 48,000 tons, would not be attempted, taking the results of the past year's work as a basis, at \$5 to \$7 per ton they approximate to a value of from \$200,000 to \$250,000 at the lowest. With the increased capacity of the mill, the skill and knowledge of the work acquired in the past both in the mine and mill, insuring a reduction of expenses, with no interference or interrup-

tion from causes as in the past, the outlook for a profitable year's run is certainly promising.

S. S. CURRY, Superintendent.
JULIUS ROPES, President.

ISHPEMING, March, 1, 1887.

The following directors were elected for the ensuing year :

Julius Ropes, S. S. Curry, William F. Swift, W. H. Rood, Ishpeming ; Dr. W. F. Carpenter, Stambaugh.

Twelve months ago there was but little ore in sight, and while everything underground presented a "healthy" appearance the mill was keeping pace with the miners, even though averaging but 19 tons per day. The introduction of a more powerful hoisting plant, air compressors and power drills provided means for more rapid advance in mining work, and the fact that there are now 38,000 tons of ore ahead of the mill above the 5th level furnishes ample proof that satisfactory progress in the way of mine development has been made.

THE YEAR'S PRODUCTION.

The following facts regarding the product of the mine in concentrates and bullion we take from the company's books. With the exception of the February yield the figures are exact. The amount of the latter month are estimated, by careful assay, and will be found substantially correct, varying but little from the returns of the mint which have not yet been received by the company :

CONCENTRATE PRODUCT FOR YEAR ENDING MARCH 1, 1887.

1886.	Ounces.	Price.	Silver.	Gold.
March	269.75 silver at	\$1.01	\$272 45	-----
	41.148 gold "	20.67	-----	\$850 53
April	100.73 silver "	98.04	98 98	-----
	31.876 gold "	20.67	-----	658 88
May	211.17 silver "	.96	202 72	-----
	27.127 gold "	20.67	-----	560 72
June	305.89 silver "	.95	290 60	-----
	43.477 gold "	20.67	-----	898 67
July	370.85 silver "	.96½	362 23	-----
	33.714 gold "	20.67	-----	696 87
August	275.61 silver "	1.00%	280 09	-----
	26.001 gold "	20.67	-----	537 44
September	381.56 silver "	1.01%	386 81	-----
	26.337 gold "	20.67	-----	544 39
October	216.93 silver "	.98½	213 68	-----
	30.283 gold "	20.67	-----	625 95
November	291.54 silver "	.99½	290 08	-----
	39.51 gold "	20.67	-----	816 67
December	152.04 silver "	1.01%	154 51	-----
	32.411 gold "	20.67	-----	669 94
1887.				
January	198.35 silver "	1.01½	201 32	-----
	153.60 silver "	1.01½	155 94	-----
February	66.33 gold "	20.67	-----	1,371 04
	gold "	1.01½	152 88	-----
	gold "	20.67	-----	607 50
Total			\$3,062 29	\$8,838 60

BULLION PRODUCT FOR YEAR ENDING MARCH 1, 1877.

Year.	Month.	Silver.	Gold.
1886.....	March.....	\$120 47	\$1,774 06
1886.....	April.....	81 21	1,887 35
1886.....	May.....	152 33	2,487 44
1886.....	June.....	222 55	4,116 54
1886.....	July.....	101 95	1,690 96
1886.....	August.....	168 74	2,602 48
1886.....	September.....	114 40	1,822 60
1886.....	October.....	104 52	1,928 26
1886.....	November.....	144 43	3,101 12
1886.....	December.....	163 57	3,133 74
1887.....	January.....	111 95	2,733 91
1887.....	February.....	105 51	2,382 87
Total bullion.....		1,591 63	29,661 33
Concentrates ford.....		3,062 29	8,838 60
Total.....		4,653 92	38,499 93

SUMMARY.

Amount silver produced.....	\$4,653 92	
Amount gold produced.....	38,499 93	
	\$43,153 85	
Number tons quartz treated.....		6,959
Average yield per ton, over.....	\$6 20	
On hand including February bullion and concentrates.....		\$3,972 50

There was expended the past year for permanent improvements the sum of \$12,000; \$8,000 were raised by an assessment of 10 cents per share.



INDEX.

INDEX.

	PAGE.		PAGE
Adventure Mine.....	266	Boston Mine.....	104
Agogebic Iron Range.....	11, 125	Breitung, Hon. Edward.....	60
Alabastine Co.....	196	Briar Hill Mine.....	33
Antrim Iron Co.....	172	Brockway, D. D.....	211
Allouez Mine.....	211	Brotherton Mine.....	160
Albion Mine.....	89	Brown, Fayette.....	171
Alpha Mine.....	162	Buffalo Mine.....	90
Anderson Mine.....	44	Burton, J. E.....	140
Anvil Mine.....	153	Cady, C. H.....	39
Appleton.....	165	Cages.....	6
Argyle Mine.....	77	Caledonia Mine.....	59
Arthur.....	164	Calumet Mine.....	124
Ash Bed Mining Co.....	276	Calumet and Hecla.....	216
Ashland Mine.....	128	Cambria Mine.....	96
Atwood Option.....	158	Cascade Iron Range.....	121-122
Atlantic Mining Co.....	250	Centennial Mine.....	215
Aurora Mine.....	133	Central Mine.....	202
Aztec Co.....	267	Christopher, J. B.....	148
Babcock, W. R.....	17	Champion Iron Co.....	112
Ball, Ed.....	47	Champion Lode.....	262
Bacon, D. H.....	71	Channings.....	163
Ball, Thomas.....	53	Chapin Mine.....	34
Bay State Mine.....	94	Chandler, J. H.....	211
Bangor Furnace.....	174	Chynoweth, Ben. F.....	258
Barnum Mine.....	80	Cheshire Mine.....	123
Barge, T.....	83	Chicago & N. W. R'y Co.....	16, 14
Beaufort Mine.....	111	Chicago Mine.....	161
Benjamin, H. M.....	159	Christopher, J. P.....	148
Belt Mines.....	263	Clark, J. W.....	222, 214
Beecher, Luther.....	94	Cleveland Hematite.....	69
Bennett, S.....	207	Cleveland Iron Mining Co.....	67
Bertie Mine.....	56	Cliff Mine.....	210
Beta Mine.....	51	Cliff Shaft.....	81
Bessemer.....	125	Coal.....	177
Bessemer Steel.....	126, 11	Colby Mine.....	149
Bice, Wm.....	40	Collins, J. B.....	147
Best, Fred.....	137	Columbia Iron Co.....	120
Bigelow, A. S.....	222	Commonwealth Mine.....	45
Blany Mine.....	57	Conglomerate Mine.....	200
Blue Jacket Mine.....	143	Copper Falls Mine.....	208
Bonnie Iron Mining Co.....	140	Copper Mines.....	200

	PAGE.		PAGE.
Copper, price of.....	3	Franklin Mine.....	237
Copper Statistics Table.....	276	Freidrich, John.....	44
Corunna Coal Co.....	180	Furnaces.....	170
Cornell Mine.....	43	Gaylord Iron Co.....	171
Crown Pt.....	161	Geological.....	15
Cundy, Capt. J.....	103-115	Gibson Mine.....	106
Curry, S. S.....	111, 133	Godfrey & Bro.....	196
Curry Mine.....	33	Gogebic Range.....	11, 125
Curnow, John U.....	21	Gold.....	269
Cyclops Mine.....	28	Goodrich Mine.....	89
Dalliba Mine.....	106	Grand Portage Mine.....	250
Daniell, John.....	230, 214	Grand Rapids Plaster Co.....	196
Davidson, O. C.....	47	Great Western Mine.....	55
Day, J.....	133	Gribben Mine.....	122
Day, Loren.....	196	Gypsum.....	195
Deer Lake Iron Co.....	175	Hagey, J. E.....	17
Delaware.....	201	Hall, Capt. J.....	215
Delphic Mine.....	61	Hall, C. H.....	75
Demmon, D. L.....	248, 241, 237	H. & C. R. R.....	—
Detroit, Marquette & Mackinac R. R.....	14, 127	Hamilton Ore Co.....	42
Detroit Iron Furnace Co.....	172	Hancock Mining Co.....	276
Detroit Iron Mine.....	99	Hartford Mine.....	100
Dexter Mine.....	104	Harris, S. B.....	236
Diamond, Capt. H.....	79	Hayward, J. A.....	153
Dickie.....	163	Hewitt Mine.....	40
Dickinson, W. E.....	45	Holland.....	164
Discoveries.....	15	Holyoke.....	163
Duncan, L. & I. Co.....	284	Home Mine.....	122
Dunstan, Capt. John.....	207	Houghton.....	162
Dunn, W. A.....	45	Hubbell, Jay A.....	158
Dunn M'g Co.....	57	Humboldt Mine.....	115
East Champion Mine.....	114	Hunt, M. R.....	54
East Norrie.....	133	Huron Copper Co.....	245
East Anvil.....	156	Indiana Mine.....	33
Edwards, T. W.....	232	Iron King Mine.....	138
Elk Rapids Furnace.....	170	Iron Age M'g Co.....	163
Emerson, B. F.....	209	Iron Cliffs Co.....	80
Emerson, L. G.....	232	Iron Chief.....	159
Emerson, R. H.....	180	Iron Mines.....	3
Erie Mine.....	120	Iron Prince.....	162
Eureka Iron Co.....	171	Iron River Furnace.....	51
Evergreen Bluff Mine.....	258	Iron River Mine.....	47
Evergreen Bluff Range.....	259	Ironsides.....	162
Fairbanks Mine.....	54	Iron Star Mine.....	55
Fayette Furnaces.....	171	Isle Royal Mine.....	249
Felch Mountain.....	123	Ironwood.....	125
First National.....	142	Ironton Mine.....	147
Fisher, H. D.....	46	Jackson Iron Co.....	171, 63
Fitch, W.....	115	Jeffery, J. B.....	97
Flint Steel Mine.....	210	Joplin, Ed.....	107
Florence Mine.....	159, 46	Kearsarge Mine.....	213
Foley, J. F.....	44	Keweenaw County.....	200
Ford, J. C.....	170	Kimberly, P. L.....	83
Foster Mine.....	80, 90	Kidder, A.....	115, 79, 93
Foster, E. T.....	43	Kimball Mine.....	56
Fowle, J. C.....	102	Kincaid, Todd.....	180
Fremont Iron Co.....	120	Kirkpatrick, J.....	121

	PAGE.		PAGE.
Knowlton Vein.....	262	Morse, F. A.....	71
Klepetchko, Frank.....	214	Moyle, J. H.....	209
Knowlton Mine.....	259	Nanaimo Mine.....	51
Kool, Frank D.....	157	National Mine.....	256
Lake Angeline Mine.....	77	Negaunee M'g Co.....	89
Lake Superior Iron Co.....	72	Negaunee Concentrating Works.....	276
Lake Superior Gold.....	269	Nevada System of Timbering.....	7
La Rue.....	163	New York Hematite.....	275
Land Plaster.....	195	Neely, B.....	100
Larsson, Per.....	39	New York Mine.....	68
Lawton, Chas. D.....	1	Newberry Mine.....	144
Lewars, Geo. H.....	201	Noble & Co.....	196
Lillie Mine.....	98	Noble, E. S.....	170
Logan.....	164	Nonesuch Mine.....	275
Lumberman's M'g Co.....	40	Norrie Mine.....	131
Ludington Mine.....	40	North Aurora.....	135
Maas, John B.....	116	Northampton Mine.....	107
Maitland, A.....	99, 97, 95, 85, 80, 83	North Pabst.....	137
Manganese.....	11	Northwestern Mining Co.....	204, 124
Marquette Iron District.....	61	North Iron King.....	144
M. H. & O. R. R.....	105	North Anvil.....	156
Martel Furnace.....	170	Norway Mine.....	162, 25
Marine Mine.....	107	Norwich Mine.....	276
Mason, Thomas F.....	233	Officer, W. J.....	100
Mass Mine.....	258	Ogima Mine.....	262
Mather, Sam.....	105	Olcott, W. J.....	130
Mastodon Mine.....	60	Oliver, Capt. John.....	29
McMillan, Jas.....	100	Oliver, Capt. Wm.....	39
McComber Mine.....	94	Ontonagon.....	256
McDonald, J. S.....	51	Orr, Geo.....	102
McGerry, Daniel.....	122	Osceola Mine.....	222
Menominee Range.....	16	Outhwaite, J. H.....	33
Merritt, D. H.....	106	Pabst Mine.....	135
Merry, Henry.....	66	Paint River Mine.....	53
Mesnard Mine.....	107	Palms Mine.....	152
Metropolitan.....	124	Palmer, Chas. H.....	201
Michigan Coal Co.....	181	Parnell, E. W.....	257
Michigamme Mine.....	100	Pascoe Mine.....	105
Mikado Co.....	157	Pascoe, Peter.....	118
Milwaukee Mine.....	92	Peninsula Mine.....	232
M. & N. R. R.....	14	Peninsula Iron Co.....	175
M. L. S. & W. R. R.....	14	Penn Iron Co.....	16
Mills.....	9	Perkins Mine.....	30
Mine Filling.....	9	Pewabic Mine.....	237
Mining Industry.....	1	Phosphorus.....	11
Mineral Range R. R.....	235	Phoenix Mine.....	106, 210
Minesota Mine.....	256	Pickands, Jas.....	105, 151
Mitchell, Capt. Samuel.....	90, 66	Pilgrim.....	158
Mitchell, Geo.....	92	Pierce, J. J.....	123
Mitchell Mine.....	86	Pioneer Mine.....	83
Moore, A. D.....	42	Pioneer Furnace.....	171
Morcum, Capt.....	45	Pine Lake I. Co.....	174
Moore, N. D.....	133	Pittsburgh & Lake Angeline Co.....	77
Moore, V. K.....	56	Pittsburgh & L. S. Mine.....	120
Monthly Products.....	274-5	Pockets.....	215
Montreal River.....	127	Pope, Graham.....	249
Morgan, David.....	118	Portland Mine.....	110

	PAGE.		PAGE.
Porter, J. N.	47, 50, 55	Stephenson Mine	32
Porter Mine	180	Sterling Mine	104
Puritan Mine	144	Standard Coal Co.	180
Presque Isle	163	Sturtevant, H. B.	76
Quincy Mining Co.	232	Stockbridge, Geo. E.	42
Quinnesec Mine	29	Stucco	196
Railroad Extension in U. P.	127, 14-15	Sunday Lake Mines	159
Rees, W. D.	118	Swanzy Mine	123
Republic Reduction Works	165	Tamarack Mine	218
Republic Iron Co.	116	Taylor, J. A.	130
Rhineland	157	Tarbell, G. E.	155
Ridge Mine	259	Teal Lake Iron Co.	96
Roberts, C. T.	60, 59, 54	Titan Mine	111
Roberts, E. S.	25	Tobin Range	164
Roberts, Sam.	87	Tod, Henry	47
Robert, J. F.	207	Tontine Mine	148
Roberts, Harry	152	Trebilcock, J.	76
Rockland Mine	256	Tonkin, Wm.	254
Rolling Mill Mine	94	Traders' Mine	45
Ropes Mine	270	Union Mills	196
Saginaw Company	89	Union Iron Co.	176
Saginaw Mine	89	Vaughn Mine	134
Saunders, A. C.	120	Victoria Mine	276
Salisbury Mine	84	Vivian, Johnson	249, 245, 237
Salt	185	Vulcan Mines	17
Sam. Mitchell (Sec. 5 Mine)	91	Vulcan Furnace	175
Scaddon, C. T. F.	54	Valley Iron Co.	148
Seabury, Chas. W.	216	Wakefield	125, 128
Sedgwick, Wm.	83	Watson & Palmer	110
Sellwood, Joseph	151	Watson & Wall	211
Selden Mine	50	Webster Mine	110
Shelden and Columbia	276	Wells & Miner Option	156
Sheldon & Shafer Mine	58	West Republic Mine	119
Sherman, J. G.	143	Wetmore Mine	107
Slope Mine	180	Wheat Mine	121
Smith, S. L.	216	Wheeler, C. M.	104, 223
Smith, Bullard & Co.	195	Wheeling Mine	94
Smith, Fred	211	White, Geo. H. & Co.	196
Smith Mine	123	Whittlesey, W. W.	61
Specular Ore	62	Windsor Mine	276
Speedwell	158	Williams, M. E.	111
South Buffalo Mine	92	Wilson, Geo.	118
Spring Lake I. Co.	169	Wilcox, Ralph	163
Spurr Mine	103	Williamston Mines	181
Stanton, John	251, 204	Winthrop Mine	86
Star Mine	158	Wolverine Mine	215
Star Coal Mine	180	Wood, J. R.	104
St. Clair, Jas. O.	120	Wright, Chas. E.	55, 108, 137
St. Clair, Geo. A.	87	Wright, Fred A.	165
St. Clair Mine	207	Wright, J. N.	218
St. Lawrence Mine	104	Youngstown Mining Co.	52

ERRATA.

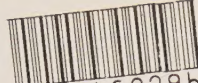
Page 222—John Danville—should read John Daniell.



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